

SCIENCE

[Entered at the Post-Office of New York, N. Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

SEVENTH YEAR.
VOL. XIV. No. 343.

NEW YORK, AUGUST 30, 1889.

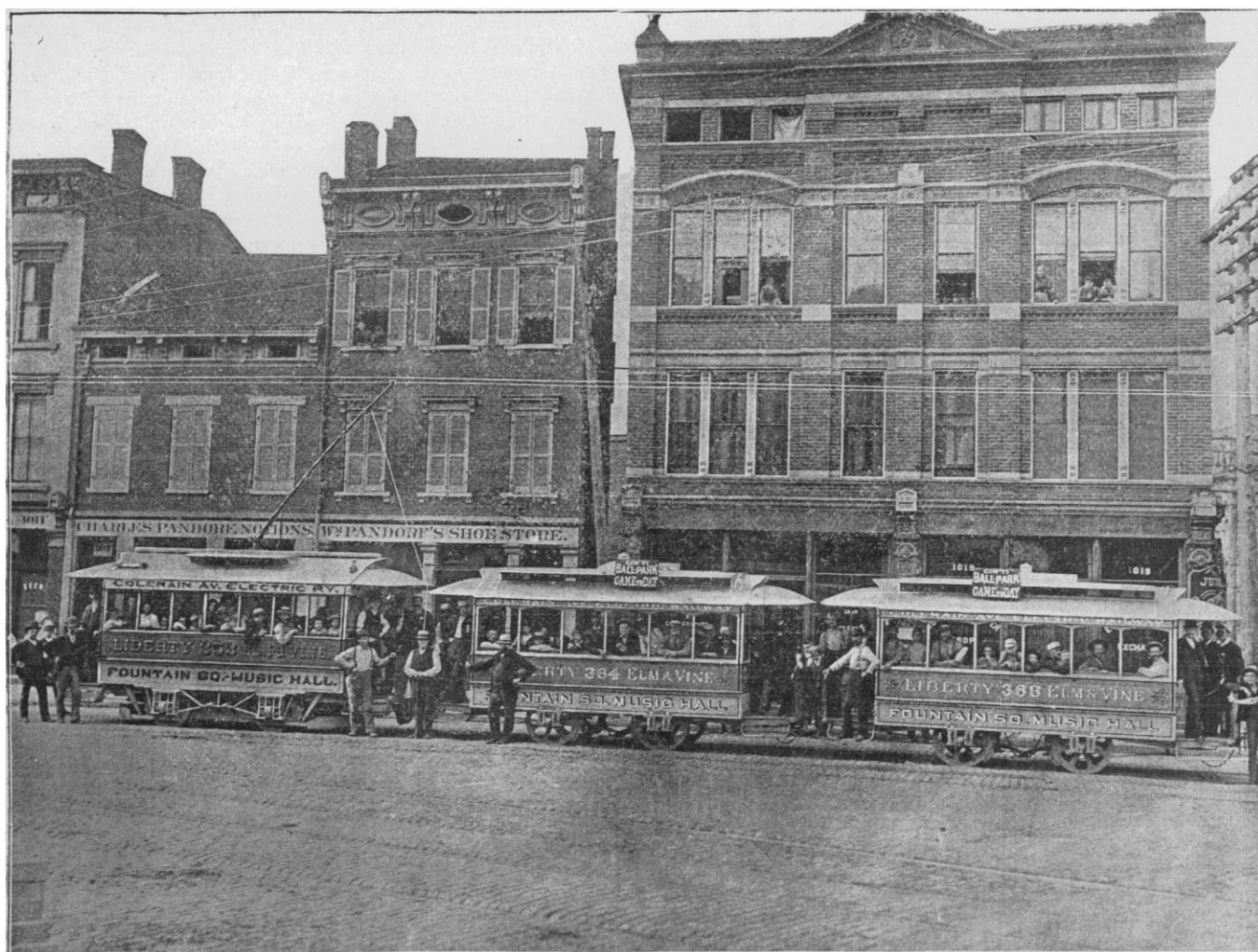
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A CINCINNATI ELECTRIC RAILROAD.

THE initial trip of the electric cars on Route 18 of the Consolidated Street Railroad Company of Cincinnati, was made on Wednesday, Aug. 6, in the presence of the president and directors of the company, and was a decided success. The system decided upon by the officers of the railroad is that of the Thomson-Houston Com-

road until two private corporations had demonstrated the feasibility and practicability of cables to enable cars to climb the steep hills which surround Cincinnati. In the same way they have gone about testing and selecting a system for electric motive power.

The company have as consulting engineer Mr. B. L. Baldwin, a young, energetic, and practical mechanic who prefers facts to theories. Mr. Baldwin studied long and carefully the various systems



THOMSON-HOUSTON ELECTRIC CARS OF THE CONSOLIDATED RAILROAD COMPANY, CINCINNATI.

pany. Elmer P. Morris, superintendent of construction, had charge of the party. The start was made from the car-barns at four o'clock in the afternoon, with fifty people in the car, all of whom were interested in the result.

The Consolidated Railroad Company are very conservative, and are not apt to spend much on experiments to improve their lines, unless assured of satisfactory results. They did not build a cable

before giving his opinion, and when he chose that of the Thomson-Houston Company, the railroad company did him the honor to close a contract with that company at once.

The present plant consists of one Corliss engine of four hundred horse-power, two Ball engines of two hundred horse-power each, and three Thomson-Houston electric generators of a capacity of 6,500 watts each. These generators furnish sufficient current to

operate eight motor cars of thirty horse-power each, and to light four horse-stables, three car-barns, and the generating station, — about five hundred lights of sixteen-candle power each.

The road as at present equipped is two and eighty-five one-hundredths miles long, and has three grades, each about sixteen hundred feet long with a three per cent rise. On the day of trial a motor car with a trailing car attached, loaded very heavily, made the distance in twelve minutes, and while on the grades the speed obtained was as high with the car added as that of the motor car by itself, showing conclusively that the Thomson-Houston motors are of sufficient capacity to do in the most satisfactory manner the work cut out for them. There is no unpleasant jerk or jar in starting the car, such as is found in many systems, and no scientific or mechanical knowledge is necessary to handle the car, which is controlled with ease.

The road when finished will be nearly six miles in length, making a round trip of twelve miles; and this, if proven successful, will be but a start in the rapid-transit line by the Consolidated Street Railroad Company. They have under way the plans for a one thousand horse-power plant for the hills, and the present plant will be enlarged to accommodate at least two more down-town lines. They also contemplate the equipment of from fifty to seventy-five cars, and expect to have the whole completed and in running order by the first of next year.

The recognition by this company of the merits of the Thomson-Houston electric railroad system is a very strong point in favor of that company; and as they gave practical demonstrations of their ability to fulfil their promises, they undoubtedly merit the honor thus paid them.

THE POETSCH FREEZING PROCESS IN MINING OPERATIONS.

A BRIEF description of the freezing process devised by Herman Poetsch for sinking shafts in quicksands and other difficult ground was given in these columns in April last. The process has been successfully applied in sinking a shaft for the Chapin Mining Company at the Iron Mountain mines in Michigan. In this case, so thoroughly and effectively was the freezing done that, although the shaft was finished some two months ago, the earth surrounding it is still frozen solid in places.

The following description of the difficulties overcome and the methods employed in sinking the shaft mentioned is furnished us by the Poetsch-Sooysmith Freezing Company of this city, who control the patents covering the process in this country.

A shaft fifteen and a half by sixteen and a half feet was to be excavated through quicksand to a ledge about a hundred feet below the surface. The mining company put the freezing pipes into the ground three feet apart, in a circle twenty-nine feet in diameter, and, with the exception of two of the pipes, down to the ledge. This proved to be a difficult task on account of the many boulders encountered. A ten-inch casing pipe with flush joints was first drilled down by various means, a drill being worked within the pipe when necessary and the material removed by jetting or by a sand pump. The casing pipe being once down to the ledge, a freezing pipe was placed inside, and the outer casing pipe drawn up and used for the next pipe. The freezing pipes left in the ground were eight inches in diameter, the lower ends being closed. Inside of these eight-inch pipes were placed pipes one and a half inches in diameter, open at the bottom. These inner pipes, as well as the outer pipes, were connected together at the top of the ground, as shown in the pipes at the left of the illustration, forming a complete circuit, through which a cold brine was circulated.

The brine used was a solution containing about twenty-five per cent of calcium chloride, which has a very low freezing point. The brine was cooled with an ice machine, having a refrigerating capacity of fifty tons of ice per day. The ammonia was compressed to about 135 pounds per square inch, and cooled by passing through coils immersed in water kept cold by pumping from a brook. Then the ammonia was allowed to expand through coils immersed in the brine and finally returned to the compressor.

The temperature of the expanded ammonia was such as to cool the brine to a few degrees below zero, Fahrenheit. This brine,

being circulated through the ground pipes, was raised in temperature about 2° F. After forty days' freezing, an ice wall ten feet thick was formed around the shaft. The excavation, commenced soon after starting the ice machine, had in the meantime reached a depth of forty feet. Thirty days more sufficed to reach the ledge. The shaft was, for convenience, curved as the excavation proceeded. This was, however, not necessary, as the walls would have stood vertically throughout the whole depth very well. The temperature of the air within the shaft was generally below the freezing point, and there was no indication of the exposed material thawing. The curbing was made of horizontal sets of timbers, sixteen inches square, placed two feet apart, with four-inch vertical plank behind the timbers. The cross walls were put in place afterwards.

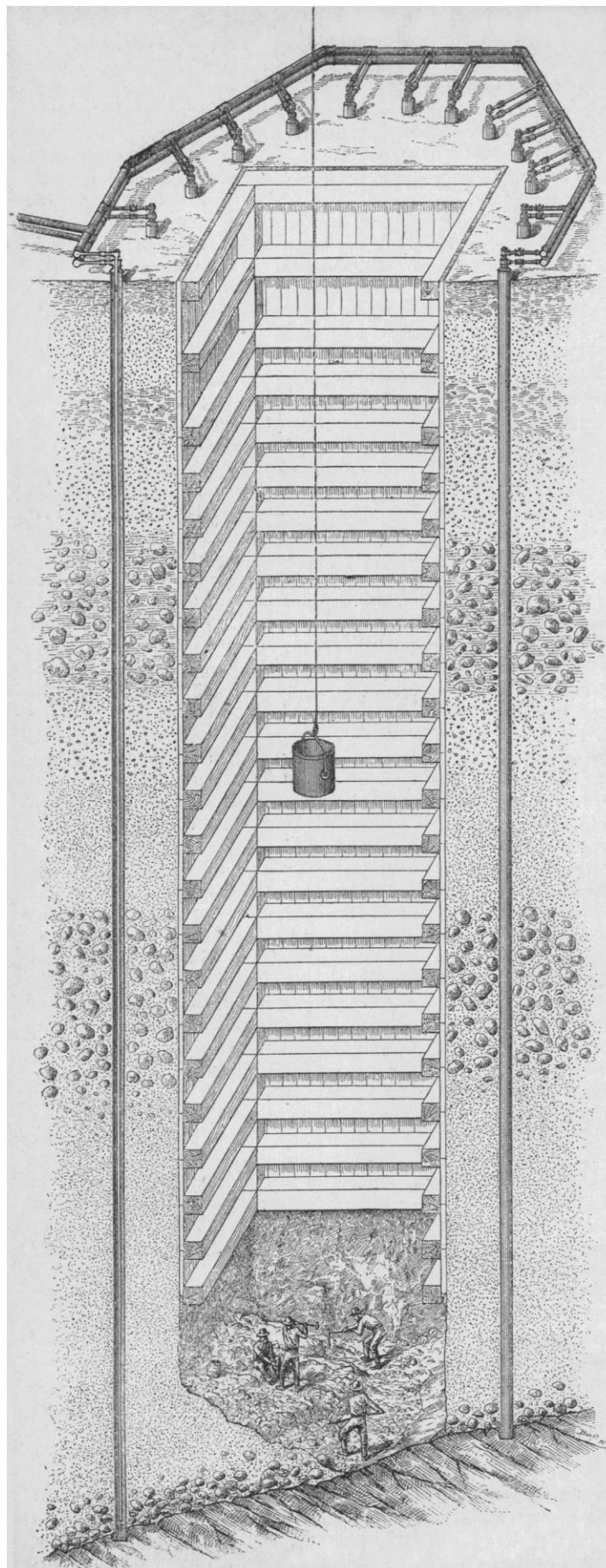
The timbering was supported from one set to another by bolts placed near the corners of the shaft, the whole system being suspended from cross timbers at the surface of the ground. The unfrozen area within the shaft grew less as the actual running time of the freezing machine increased. By the time a stratum of boulders was encountered, the frozen area reached nearly across the shaft; but when quicksand containing a large percentage of water was passed through, the unfrozen area was greater. The reason of this is readily understood when it is remembered that the specific heat of water is about five times as great as that of any of the other materials, and therefore the strata containing most water would require more cold and would be longer in freezing.

The hardness and appearance of the fractures of the frozen quicksand approached those of sandstone. Granite boulders embedded in it showed a decided tendency to fracture across rather than break loose. The tensile strength of the frozen ground, as determined by a cement-testing machine, was equal to that of the best neat Portland cement, and varied from 350 to 450 pounds per square inch, and its strength against crushing, as determined from inch square cubes, was 850 pounds per square inch. This furnishes data from which the strength of the surrounding frozen wall may be computed as an arch. An ice wall ten feet thick will be found sufficiently strong for any case likely to occur. Near the bottom the freezing extended within the circle solidly ten feet from the pipes. It is not known how far it extended outside, as no borings could be made through it. A test pit was sunk outside the shaft as far as the water would permit (some fifteen feet), and from this it appeared that the freezing extended outwardly from the pipes about three-fourths as far as within the circle.

The material was mostly loosened by picks and chisel bars. Powder was used for blasting for a considerable time, but this was discontinued for fear the concussion might injure the pipes or fracture the wall. The material was hoisted out by an iron bucket, which also took out the water that stood in the unfrozen centre. There was no appreciable inflow of water until the excavation had reached nearly to the ledge, when a small amount was noticed.

On reaching the ledge, it was discovered that it was so fissured and disintegrated as to allow water to come in under the frozen wall at a corner in the vicinity of one of the pipes that did not extend to the ledge. The shaft was allowed to flood, water being pumped into it at the same time to prevent as much as possible the flow of water through the opening. An eight-inch freezing pipe was put in place in the shaft, the foot being directly at the opening, and earth was piled around it, the purpose being to freeze the leak off. Then cold brine was circulated through the whole system of freezing pipes for ten days uninterruptedly, when the water was pumped out, and the seam was found to be quite closed; but there was still a small amount of percolation through the ledge, requiring occasional pumping to clear the shaft; ice had collected several inches thick on the side shaft, and several feet in the corner, where the extra freezing pipe was placed.

The work of removing the earth which had been thrown in and the clearing up of the bottom continued for two weeks, when the water from the ledge increased at such a rate that it was decided to lay short auxiliary freezing pipes against the leaks and freeze the ledge itself. This was done, the shaft was flooded again, and the brine circulated thirty days. When the water was pumped out, the leakage was found to be small, and excavation was proceeded with. The soft, shaly rock was removed till a hard bear-



POETSCH FREEZING PROCESS IN SHAFT SINKING, AS APPLIED
AT THE CHAPIN MINE.

ing was obtained for the timbers, and the timbering was completed from the surface of the ground to the excavated depth.

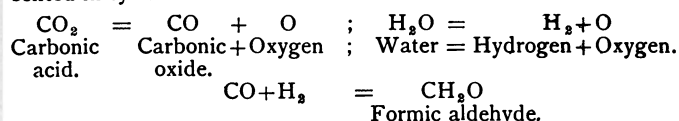
The obvious remedy for inflow from the rock will be in the future to put the pipes far enough into the ledge to freeze off the surface seams. Pipes are now being put down for a coal mining shaft at Wyoming, Pa., and they will be put several feet into the rock, which will no doubt intercept all troublesome percolation.

This operation of this process was the first application on any considerable scale in the United States. Water is the engineer's most troublesome enemy, and its conversion into a barrier of defence is a triumph of engineering as effective as it is novel. This process can be applied to excavations for bridge piers, to tunnels, and to other general work of a difficult and expensive character as well as to shafts. But in shaft work alone it should be invaluable, as by it numerous valuable deposits of coal and other minerals, now inaccessible on account of overlying strata of water-bearing materials, can be reached, as in the case of the Chapin mines, and in those Belgian coal mines which first led Mr. Poetsch to devise his process.

THE PRODUCTION OF SUGAR.

YESTERDAY the formation of sugar by plants, says Ward Coldridge, in *Knowledge*, was one of the mysteries of nature. Chemists and botanists, while they knew that ordinary chemical attractions must be the cause, were yet completely in the dark as to how these forces worked. They realized that plants started with carbonic acid and water, and from these waste products of animal existence built up in some unknown way the complex compound, sugar. From the deadly choke-damp to the luxury sugar was a great transformation. The plants could thus build, but men of science could not comprehend the process.

To-day, as the result of some brilliant researches, the explanation has been found. A simple compound, the formation of which by the plant can be readily accounted for, has been transformed into a sugar. To understand the process, it must be realized that abundant evidence proves that plants promote processes which are the opposites of combustion or oxidation. Plants liberate oxygen from its compounds, and absorb that with which it was previously combined. They can liberate oxygen from so stable a compound as carbonic acid, and in water find a source for the hydrogen which is essential to their development. The products which could thus be formed are, respectively, from carbonic acid, the lower oxide of carbon and oxygen; from water, the gases hydrogen and oxygen. Experiments have shown that under the influence of the silent electric discharge, and even without it, carbon monoxide and hydrogen combine to form a simple compound, formic aldehyde, which is immediately connected with the formic acid of the ant and of the stinging-nettle. So the changes which occur in the plant under the combined influence of sunlight and chlorophyl may be represented in symbols as follows:—



This formic aldehyde was the substance experimented on. When it was suitably treated in the presence of the hydrate of lime, $\text{Ca}(\text{HO})_2$, it was induced to combine with itself and to form another compound. The latter is composed of the same ultimate indivisible particles (atoms) and in the same proportions; but they are now differently arranged side by side, and with a larger number in the unit aggregation which chemists call molecules. This compound has now been finally proved to contain not one, but at least two or three members of the family of substances, carbohydrates, to which sugar belongs. Thus in our laboratories can now be imitated the process of which plants previously held the secret.

While, however, the fact is marvellous that a sugar has been obtained artificially, it must be remembered that the process is absolutely uneconomical, for the yield is very small. This remark, too, applies to another process of artificial production. The sweet viscid liquid, glycerin, and its stinking, irritating offspring, acrolein, which gives the nasty smell of burning fat, have both been transformed into sugar; but the quantity obtained is very small in pro-

portion to the glycerin or acrolein used. The importance of these researches lies in the fact that they show how the chemical changes which characterize the vital action of the plant can be imitated with dead matter, and that, further, they shed a bright gleam of light on the hitherto obscure question of the arrangement of the indivisible particles, atoms, within the compound particles, the molecules of these substances.

Our supply of sugar will always be drawn from the vegetable kingdom, the synthetic laboratory of nature. Many plants work hard and economically at the production of sugar, and form it in quantity. It occurs in all parts of plants, — root, stem, leaves, flower, fruit, and seed. In some grasses it is very abundant, in the sugar-cane, in the sorgho grass, and in the young shoots of the maize. In the common carrot and parsnip, and especially in the fleshy beet, large quantities are contained. But for its commercial extraction two sources are chiefly used — the sugar-cane and the beet-root, and a third is of growing importance, the sorgho grass.

The sugar-cane has far greater natural advantages than the beet-root. At one time the former held the field without a rival. But during the Napoleonic wars, France was deprived of her supply of sugar, and she was driven to produce her sugar at home. This resulted in the commencement of the beet-sugar industry, and thus amongst the secondary results of war must be reckoned bounty-fed sugar. To judge of the economic aspects of the two industries, many factors have to be taken into account. When that has been done, this balance will be found distinctly in favor of the cane. Sugar-canes contain sufficient sugar to yield seventy to eighty per cent of their weight of juice, in which there is some twenty per cent of sugar. Beet-roots, as an extended series of investigations have shown, possess a percentage of sugar varying from seven to a maximum of under fourteen, and on the average about eleven. Now an acre of land which can be used for beet-growing will be rented for, say, £4 per annum, while in the colonies an equal area of cane-producing land will be rented for about one-tenth of that amount.

Further, a great divergence is found in the quantity of beet and cane which two equal areas can grow. For instance, in the environs of Magdeburg, an acre will yield about ten hundred-weight of sugar; whereas, in the home of the sugar-cane, some forty to fifty hundred-weight can be obtained. Then other items in the cost of production have to be considered; the difference in wages in the two regions, the difference in the cost of fuel, — in Europe where coal is necessary, in the colonies where the waste matter of the cane supplies the whole, or nearly the whole, of the fuel required. One can thus realize the grounds on which the Brazilian commission on the sugar industry reported, that, in their opinion, "the cost of production may be reduced in Brazil to such a degree as to defy competition, and the struggle between cane and beet-root must become ominous to the latter, which thrives only by the artificial advantages which European countries have devised."

Hitherto the artificial advantages have been on the side of the European countries; but now the greatly improved means of transit, and the diffusion of knowledge, are raising the colonies to a position nearer equality in these respects, of course excluding bounties. And by this time the colonial sugar planter has learned a severe lesson. He understands that, while nature has showered her gifts on him with a lavish hand, she mercilessly punishes him for carelessness and lack of promptitude. For if he cuts his canes, they must within a few hours be crushed and extracted; if he is negligent, and leaves them for only two days, fermentation rapidly ensues under the conditions of tropical temperature, and the canes turn sour and must be thrown aside for fuel. In this way nature has fined men whole fortunes.

FATTENING LAMBS.

At the Cornell Agricultural Experiment Station some experiments have been carried out recently on the effect of different rations on fattening lambs, under the direction of Professors J. P. Roberts and Henry H. Wing. These experiments were, in the main, a continuation of those carried on at this station one year ago, and very nearly the same foods were used, none of them being out of the reach of the general mass of farmers.

The period of feeding lasted five full months, from November 25, 1888, to April 25, 1889. The lambs, twelve in number, were selected from a lot that had been picked up in the surrounding country for shipment. They were coarse wool grades, Shropshire or Southdown, dropped late the previous spring, and had evidently been scantily fed during the summer. They were not such animals as would have been selected to give the best financial results, but being thin in flesh and fairly uniform, were well adapted to the purposes of the experiment. The twelve were closely shorn, and then divided into four lots of three each, in such a manner as to have as nearly as possible an equal weight in each lot. Three lambs were used in each lot, so that if for any reason there should be an accident to one there might be two left at the end, from which to gather data in regard to the effects of the rations.

The lots were numbered respectively III, IV, V, and VI, and each lamb was labelled with a separate numbered ear-tag, so that data in regard to increase in weight, etc., could be collected individually and by lots. The experiment progressed satisfactorily from beginning to end, with but two exceptions.

Lot III was fed what may be called a carbonaceous ration. The lambs were given all the timothy hay and whole corn they would readily eat, and in addition about a half pound of roots each per day. Turnips were fed as long as the supply lasted, after that mangels were used.

Lot IV was fed a nitrogenous ration, although it was not so excessively rich in nitrogen as that used by some experimenters in trials of this kind. The grain ration was made up of two parts wheat bran and one part cotton-seed meal. A pound per day per lamb of this mixture was fed at first; afterward it was somewhat increased or diminished, as the needs of the case required, the object being to feed about all that would be readily eaten. This lot received clover hay instead of timothy, and roots, as lot III.

Lot V was fed an intermediate ration. The grain part was composed of three parts corn and one part each of wheat bran and cotton seed meal. It was eaten in about the same quantity as lot IV. Timothy hay was used for this lot, and roots were fed as in each of the others. Lot VI was fed the same as lot V, except that they received no roots at all.

The lambs had access to water the whole time. In the winter it was warmed to about 80° before being offered them. The weight was obtained in the following manner. A pail of water was weighed and placed in the pen, where it remained till the next morning, the sheep drinking whenever they wished. Each morning the pail, with whatever water remained in it, was weighed back, the difference in weight being the amount consumed. A fresh pailful was then weighed out, and the process repeated. This was kept up during the whole course of the experiment. The water was warmed when it was first put in, and during the cold weather the lambs soon learned to take nearly all their water as soon as fresh water was given them. From the first a marked difference was seen in the amount of water consumed by the different lots, and this difference continued through the whole course of the experiment. The total amount of water drank was as follows: Lot III drank 308 pounds, or 1.03 pounds per lamb per day; lot IV drank 1,185 pounds, or 3.95 pounds per lamb per day; lot V, 735 pounds, or 2.45 per lamb per day; lot VI, 847 pounds, or 2.82 per lamb per day.

The very much larger quantity of water consumed by the lambs fed a highly nitrogenous ration is at once apparent. It will be seen that lot IV drank nearly four times as much as lot III (fed carbonaceous food), and about 60 per cent more than lot V. These three lots were all fed roots in equal kind and quantity, so that it would seem that the different amounts of water consumed must be due to the nitrogen in the ration.

Lots V and VI were fed on the same ration, except that lot VI had no roots. Probably for this reason they drank about 15 per cent more water. The lambs fed on nitrogenous food, or lot IV, made much the largest average gain, and those fed on carbonaceous food, lot III, made the smallest gain, though not very much smaller than lot VI. Animal individuality, a very perplexing consideration in all work of this kind, showed its influence very strongly.

Notwithstanding the gain in live weight was very markedly in

favor of the lambs fed on nitrogenous food, it is when we come to compare the amount of gain in relation to the amount and cost of the food consumed that the most striking figures are brought out. Both in the amount of food consumed for one pound of gain, and the cost of gain per one hundred pounds, the advantage is very markedly in favor of lot IV, the lot fed on nitrogenous food. It costs a little more than a cent and a half per pound, or twenty-six per cent more to put a pound of gain upon the lambs that were fed on corn, timothy hay, and roots than it did to put a pound of gain on those that were fed wheat bran, cotton-seed meal, clover hay, and roots.

The lambs were shorn Nov. 15, or ten days before the beginning of the experiment. They were shorn again the day before they were slaughtered, so that the wool obtained was the growth of 160 days. The weight of the wool from both lambs in each lot was, lot III, 4.25 pounds; lot IV, 7.31 pounds; lot V, 6.63 pounds; lot VI, 6.19 pounds;—the last three lots showing an increase over lot III of 72, 56, and 46 per cent respectively. This coincides with the results of the experiments last year, in that nitrogenous food seems to largely affect the growth of wool. It seems to show further that even a small increase in the nitrogenous matter of a ration has a decided influence on the growth of the wool, for lots V and VI, whose ration was intermediate in character, gave very nearly as much wool as lot IV. In the experiments of 1888, already referred to, the percentage was not so great in favor of the lambs fed on nitrogenous food.

The lambs were slaughtered on April 25. The blood was carefully caught in a clean pail, and it and all the important internal organs were weighed. The carcasses were hung up in a cool place to stiffen for two days, and were then cut up, and the parts carefully examined. Before they were taken down, however, they were weighed and most carefully inspected by the different members of the staff. The most striking difference that was apparent, as the carcasses hung upon the hooks, and after they were cut up, was the evident leanness of the two belonging to lot IV, which had been fed nitrogenous food. The kidneys were not covered, and there was very little loose fat next the skin, while in all the other carcasses the kidneys were more or less completely covered, and there was a layer of tallow of greater or lesser thickness between the skin and body. The carcasses of lot III had the most of this tallow. The same thing is shown in the amount of caul fat and kidney fat. While an expert butcher would have undoubtedly selected the carcasses of lots V and VI as furnishing the most saleable mutton, the carcasses of lot IV had little or no unpalatable adipose matter, and those of lot III showed much the largest percentage of waste fatty matter about the root of the tail and in the flanks.

The weight of evidence of all of the experiments at Cornell, together with results obtained by other experimenters in the same field, seems to show: that corn, as an exclusive grain ration, does not give the best results, either in amount, quality or economy of production, when fed to growing or fattening animals; that the amount of water drank, especially in the case of these lambs, is a pretty certain indication of the rate of gain; and that the production of wool is very greatly dependent upon the nitrogen in the ration.

The value of the manure made from the animals fed is a matter of prime importance, to all eastern farmers at least. And often the manure left on the farm represents a large part, if not the whole, of the profit made from feeding a lot of animals. For this reason there were calculated the manurial value of the rations fed the different lots. From this it appeared that while the first cost of the ration of the nitrogenous fed sheep was larger than that of the carbonaceous, yet when the value of the manure is subtracted, the cost of the former is less than half of the latter.

PEARL OYSTERS.

THE presence of nodules or tubercles on the interior surface of the shells or valves of lamellibranch (bivalve) mollusks is of frequent occurrence. These excrescences are nacreous or otherwise, according to the character in this respect of the shell in which or upon which they occur. They are found alike in fresh-water and marine species. In the pond and river mussels they are chiefly due to interior causes; in marine forms, like the cockles, mussels, the

scallops, etc., these formations are generally traceable to exterior causes. It is often the case that specimens of the large scallop of the New England coast are so burrowed into by a species of sponge that nearly the entire inside surface of the valves will be roughened with sharp, thickly-set pustulæ. In all the marine species in which those nodules occur it will usually be found that the substance of the shell has been bored into from the outside by either a species of pholad or lithodomus.

Neither of these forms are, properly speaking, either parasites or commensals. They are, more definitely, "domiciliares," as stated by Mr. Robert E. C. Stearns of the Smithsonian Institution, and excavate their burrows, not for the purpose of getting at the softer parts of the mollusk upon whose shell they have "squatted" in order to use said softer parts as food, but solely for the purpose of a residence or domicile.

The burrows of these shell-boring pholads and lithodomi are at first quite small, increasing in size in the same ratio as the burrower increases in age or in growth. After a while the depth of the boring is equal to the thickness of the shell in which it has been made, and the occupant of the latter, in order to keep his own shell intact and maintain the integrity of his own domicile, commences depositing layer upon layer of nacreous or porcellaneous matter, as the case may be. In keeping pace with the continued encroachments of the domiciliary squatter upon the outside, this deposit finally becomes a more or less conspicuous protuberance.

Sometimes these nodules or tubercles are due to some foreign inorganic matter, a particle getting in between the mantle of the mollusk and the inner surface of its shell. In such cases it is, we may say, at once plastered over, and thus fixed upon the surface of the valve. Free concretions, i.e., unattached or non-adherent nodules, are, as is well understood, caused by some particle, organic or inorganic, becoming in some way lodged exclusively in the soft parts of the body of the mollusk, and so far away from the surface of the shell as not to admit of its being cemented to it.

No doubt many of the mollusca, both gastropod and lamellibranch, contain or are inhabited by true parasites. In certain species of fresh-water mussels a species of water mite has been detected, and sometimes thread worms and other forms occur.

A small species of crab, an epicurean no doubt, finds a salubrious habitation in the common oyster, but parasites of any considerable size appear to be rather rare. Besides the species above referred to, another small crab is sometimes found in the common mussel and the large scallop before mentioned. It is doubtful, however, whether these crabs are really parasites or only commensals, though probably the former.

There is, however, evidence of the occurrence of fishes of two species as parasites in the true pearl oyster, or mother-of-pearl shell, not by the presence of the living fish, or even by dead specimens of "fish in the flesh," if we may use so convenient a paradox, but by their entombed remains in the form of nacreous nodulæ or tubercles on the shells or valves of the said mollusk.

At a meeting of the Zoological Society of London June 1, 1886, Dr. Günther exhibited a specimen of a small fish of the genus *fierasfer* embedded in a pearl oyster, and said: "This specimen is an old shell, in which there is imbedded, behind the impression of the attractor muscle, a perfect individual of a fish belonging to the genus *fierasfer*. The fish is covered by a thin layer of pearl substance, through which not only the general outlines of the body but even the eye and the mouth can be seen. The parasitic habits of *fierasfer* are well known. The fish, instead of introducing itself into the cavity between the two halves of the mantle, penetrated between the mantle and the shell, causing irritation to the mollusk, which the latter resented by immediately secreting the substance with which the intruder is now covered. It is remarkable to note that the secretion must have taken place in a very short time, at any rate before the fish could be destroyed by decomposition."

After entering the shell, which of course must be at such time as the valves are partially open or gaping, these fishes find no obstruction to their course as they push their way towards the interior between the mantle and the smooth inner surface of the valves until they approach the adductor muscle, and here they find a barrier which most likely causes them to expend somewhat greater ac-

tivity or energy, and consequently in a correspondingly increased degree disturb the serenity if not the structural economy of the oyster.

Having reached thus far, the invader is in the immediate vicinity of, if not the seat of intellect, the centre of sensitiveness. The deposit of nacre in such instances must be very rapid; and it is quite possible that the unwelcome explorer is not only enshrouded and entombed in pearl, but previously drowned in a pearly flood, for it may be reasonably presumed that the annoyance caused by its presence must be exceedingly great, and likely to induce a copious flow of nacreous lymph at the point and in the region of greatest irritation. It is evident that the deposition and induration are sufficiently rapid to inclose the parasite before decomposition has taken place.

THE WORLD'S FAIR OF 1892.

AMONG those who have volunteered suggestions as to the scope of the exhibition to be held in 1892, is Mr. Edward Atkinson. Although it may be said that Mr. Atkinson overlooks the main cause for the holding of such an exhibition, which is that it serves merchants and manufacturers with a good means of advertising, yet as his letter contains so many good suggestions likely to improve the tone of the exhibition we quote literally from it. Mr. Atkinson writes:—

I have watched with some interest the course of the discussion on the exhibition proposed for 1892. I have had a little experience in such matters, and have given some thought to the subject. . . . It seems to me that the day has gone by for a great world's fair or bazaar, in which all kinds of goods and wares may be displayed, largely for purposes of advertising them, without much system or method and without any distinctive purpose in the general scope or plan of the exhibition, except to make a great show. Any one who desires to study or observe such goods and wares can find a better exhibition in the shop windows than has ever yet been put together in a world's fair or bazaar. Such fairs are cumbrous, costly, tiresome, and unsatisfactory. The time was when they were novel, interesting, instructive, and useful. The diplomas are, as a rule, of little or no value. I exhausted the dictionary at the Centennial of 1876 in trying to vary the diplomas which we gave substantially to every one who made an exhibit in our group, and the few who were refused afterwards appealed to the higher powers, and obtained their diploma or certificate of excellence. . . . There was, however, one conspicuous exception in the Centennial to the generally commonplace character or want of distinct purpose in the method of exhibiting. The Kansas and Colorado exhibit of natural products and resources laid the foundation of the progress of agriculture and mining in that section.

When I was called upon to advise how the exhibition at Atlanta should be laid out and directed, my first conception was to bring together every thing that could be exhibited or made known in regard to cotton, not only in respect to the fibre but in respect to the seed and the plant. Presently it became apparent to me that such an exhibition would tend more and more to the concentration of Southern efforts upon cotton only and would stand in the way of the diversity of industry which that special section especially needed; I therefore conceived the plan of imitating the Kansas and Colorado exhibit, and advised the directors to interest the Southern railroads, the owners of land, and the owners of mining property in bringing together that wonderful collection of timber, minerals, and the products of the soil which really formed the most important part of the so-called Cotton Exposition. . . . When such men as the Innans and others assure me that the effect of that exhibition and the carrying out of that specific suggestion made the real starting-point in the progress of the South in all the arts which are now gaining so rapidly, and made known to the Southerners themselves, as a body, the magnitude of their own resources, which had hardly been conceived even by the few, I can no longer resist the conclusion that mine was a happy thought, and that I did contribute in considerable measure to the progress and prosperity of the Southern States. Of course, in the nature of the case, the progress would ultimately have been made, but the great and early start is dated from the Atlanta Exposition.

The motive of the exhibition in 1892 is that the year recalls the

date of the discovery of America by Europeans four hundred years ago. Ought not the motive of such an exhibition to be the progress in human welfare in four hundred years, through the application of science and invention to the pursuits of peace? Ought not such an exhibition to illustrate the interdependence of nations, the growth of commerce, and of modern industry, — prophetic of the time when war shall be forbidden at the command of commerce? Four hundred years ago the invention of gunpowder had only begun to promote equality in the conditions of men; it had only begun to make the power of the serf equal to that of the seignior; it had only begun to do away with the dominion of privilege, and to establish the dominion of human rights; it had only begun to alter the relations of men in the exchange of services from distribution according to status to distribution according to contract. The invention of printing had only begun to diffuse intelligence; it had only begun to make possible and to establish a system of common law; it had only begun to make known to the poor and feeble that He who created the world ruled all things well and recognized no difference among men because of race, birth, condition, or color. The long struggle for equal rights, first taking the form of resistance to superstition, and of wars waged nominally on religious grounds, was soon converted into a system of war waged by nations in order that the so-called civilized nations of Europe might each on its own behalf dominate sections of the new world, and control by force and by colonization the commerce of the continents or of parts of continents secured by war for the sole benefit of the European countries, each for itself, by whom this dominion had been gained.

It is only within the last century of the four, or only since the physiocrats of France first entered upon the study of the relation of men to each other, and since the publication of the "Wealth of Nations," by Adam Smith in 1776, that the true function of trade and commerce has begun to be conceived among civilized men. Even at the present time the continent of Europe, which, if we separate the uninhabited portions of Norway, Sweden, and Russia, is about equal in area to the area of the United States, omitting Alaska, is divided up into substantially nineteen separate empires or States, each cut off from the other by barriers to mutual service and restrictions upon their traffic, at which barriers taxes are levied upon commerce; the avails of such taxes being more than expended in the support of armies and navies which, except for these barriers to mutual service, would not be required. Witness on the other hand, the growth and progress of this nation. The freedom from obstruction to mutual service among its citizens which was established in our organic law, in that provision of the Constitution which forbids any interference with commerce between the States, is without question the rule to which we owe more than to anything else, the preservation of the Union and the freedom from the blood tax, as well as the money tax of a standing army.

My ideas run away with me in trying to give my conception of what the exhibition of 1892 might be. My conception is yet somewhat vague. My general idea is that either by way of examples, of pictures, of graphic illustrations, and of figures, one and all combined, so far as may be, the exhibition should show the progress of modern art and industry from the pre-historic type, or from the type of 1492, down to the present day.

For instance, the art of weaving is older than history. The pre-historic loom was the same as the loom on which nine-tenths of the material for clothing the people of China is now woven — the same as the hand-loom which even to-day is in operation in the southern mountain valleys of "the land of the sky," in Kentucky, in Tennessee, and in the Carolinas — the same as the hand-loom on which the French *habitans* of Lower Canada still choose to make the fabrics with which they are clothed. It would be easily possible to give the examples in action of the whole art of weaving within the limits of a small section of a great exhibition building, the Chinese, African, South American, homespun American, and the modern, all in contrast; the Arab weaving shawls, the Daghestan carpets, the Navajo Indian blankets, etc., on the walls of which section could be pictured geographically the relative demand and supply of the different sections of the globe for the products of the loom.

The art of spinning could be illustrated in the same way; . . .

and the same conception might be adopted with respect to the art of milling, preparing grain, and making bread.

It is sometimes affirmed that there is no science of political economy. Such an exhibition as I have sketched in this somewhat visionary way would show in a concrete form the very object-lessons with which the political economy must deal; and I think one would soon predicate on the record of the past four centuries the possibilities of the next, yet it has only been within the last century that covers the existence of this nation that the chief part of this progress has been made. This has been the century in which an abundance of metals, which lie at the foundation of all arts, have been placed at the disposal of the science of metallurgy. It has been the century in which heat has been converted into power by methods which are even yet crude and imperfect; it has been the century in which time and distance have ceased in a great measure to obstruct the mutual services on which human welfare depends. We stand at the beginning of the century in which known agencies or new directions of energy—new inventions of which we can only dimly perceive and forecast in the future—will alter, change, and ameliorate the conditions of men in even greater measure than the inventions of the past, the only conditions precedent and necessary to such progress in welfare being that there shall be commensurate progress in the general intelligence of the people, especially of those who are chosen to legislate for them, equal in its measure to the progress in the arts.

Therefore the final objective point of this proposed exhibition of 1892 might well be to make it an object-lesson illustrating the interdependence of men and of nations, and their power to serve each other, in all the arts of peace which make for plenty. . . . It goes without saying that if any such comprehensive plan should be undertaken, a specific call would be made upon each State to make an exhibit of its power of serving others, by bringing together its minerals, its timbers, and the products of its soil and its forests, in a thoroughly systematic way,—after the manner of the exhibits of Kansas and Colorado in the Centennial, and after the manner of the exhibits of the Southern minerals and timber at Atlanta.

ELECTRICAL NEWS.

ATMOSPHERIC ELECTRICITY. — A study of the electric phenomena produced by solar radiations was presented at a meeting of the French Academy on Aug. 5 by M. Albert Nodon. Numerous observations made at the laboratories of the Sorbonne and the Collège de France show that on meeting an insulated metallic or carbon conductor the solar rays communicate to it a positive electric charge; that the amplitude of this charge increases with the intensity of the rays and decreases with the hygrometric state of the air, the phenomenon attaining its maximum value in Paris about 1 P.M. in summer, when the atmosphere is pure and dry; lastly, that the effects cease during the transit of clouds across the face of the sun. If these results can be extended to non-metallic bodies, then solar radiation may be regarded as one of the causes of the electrization of the clouds.

A NEW LAMP. — M. Henri Pieper, of Liège, has just invented a new incandescent lamp of very simple construction. It consists of two horizontal rods of copper placed about four millimetres apart. A thin pointed rod of carbon, placed vertically, rests on the copper rods and forms a bridge between them. The current passes between the copper rods through the carbon, which it renders incandescent. The copper rods are mounted on springs, which cause them to rise slightly when the carbon is totally consumed, and bring them against two contact pieces, thus preventing the rupture of the circuit.

HEALTH MATTERS.

THE KOLA-NUT. — The value of the kola-nut (seeds of *Sterculia acuminata*) as a dietetic and therapeutic agent has been recently tested by surgeon R. H. Firth, according to the *Lancet*. These nuts are allied in composition to cocoa, coffee, and tea, but contain a relatively large amount of caffeine. The properties ordinarily assigned to kola are those of a strong tonic and stimulant to the nervous system, counteracting and removing the sense of

exhaustion after fasting and fatigue; it has also been credited with having an antagonistic action to alcohol, and it has been said to purify water. From his observations surgeon Firth concludes that kola is in no sense a food; that it increases the total urinary water with a slight reduction of its total solids, and a marked reduction of the extractive; that it has a peculiar stimulant action on the nervous system; temporarily strengthens the heart-beat, and increases the arterial tension. In times of exertion and fasting it wards off the sense of mental and physical depression and exhaustion. As a therapeutic agent in convalescence, and as an antagonist to alcoholic sequelæ, kola has not yielded any positive results in surgeon Firth's hands. For the purification of water it does not appear to be superior to other mucilaginous seeds, its action being purely mechanical. In this report due prominence is given to the importance of separating seeds which contain no caffeine, such as *Garcinia kola* and *Sterculia cordifolia*, as these would speedily discredit the employment of kola by the troops under conditions when it might possibly be of service. It appears that an infusion, from its astringent action, might be used for those suffering from diarrhœa.

NEAR-SIGHTEDNESS. — Dr. Duclaux has communicated to the Academy of Sciences, in the name of Dr. Boucheron, says the Paris correspondent of *The Medical Record*, a note relative to hereditary myopia and its treatment in adolescence. The children of myopes are not born myopes; they become so, but at an age more and more young, according as generations succeed. Thus, a grandfather who became myopic at twenty years, having a son myopic at fifteen years, they would both have a slight myopia, and would be able to read without spectacles in their old age; but their grandchildren will become myopic at twelve years, and will already have been so to a great degree. The great-grandson will be a myope at eight years, will arrive at six dioptries of myopia at fifteen years, at eight dioptries at thirty years, will lose an eye at thirty-five years, and will have great difficulty in preserving his second eye to the end of his days. It is therefore necessary that this state of things should be more rigorously attended to. Dr. Boucheron remarked that in children somewhat the same thing happens with the muscles of the eye as what occurs in writer's cramp. The child strains in writing, contracts himself, and there is produced cramp of the accommodation of the eye, and this abnormal accommodation tends to become permanent in myopic pupils. Dr. Boucheron examined one hundred lycéens, and took the measure of their myopia. He instilled atropine into their eyes, and their myopia was modified. Hence, beyond the principles of hygiene, so easy to institute, he recommends the employment, in feeble doses, of atropine, duboisine, or simply cocaine.

EAU DE COLOGNE TIPPLING. — It is said that the practice of drinking cologne is becoming very common both in Europe and in this country, and, as an indication of this, that the sale of the perfume has increased greatly of late years. Women are more addicted to the habit than men, and a writer in the *Quarterly Journal of Inebriety* says that the presence of obscure and complex nervous disorders in a woman who uses cologne externally should always suggest the possibility of its internal use.

HYGIENE CONGRESS. — The Hygiene Congress at Paris brought its labors to a close on Aug. 10. Among the subjects discussed during the week was that of the pollution of rivers. The congress decided, says *Nature*, that the pollution of underground water-courses and of rivers by the residue of factories should in principle be forbidden, and that water from factories should not flow into a stream till it had been proved to be absolutely free from all injurious substances. The congress was strongly of opinion that the most perfect method of purification was by irrigation. This, of course, must, in certain cases, be preceded by such mechanical and chemical processes as would render the water fit for agricultural purposes. It was related that many manufacturers had benefited by the application of the law, as in their efforts to prevent the pollution of watercourses they had made discoveries enabling them to utilize waste products. The difficulty was with the smaller manufacturers, who were not rich enough to take the necessary measures. The congress decided that where persistent resistance was displayed

the authorities should themselves execute the works prescribed for the purification of the water, and compel the persons interested to pay the cost.

NOTES AND NEWS.

THE United States Hay Fever Association held its sixteenth annual meeting on the 27th of August, at Bethlehem, N.H.

— The Congress of Physiological Psychology held in Paris recently is considered to have been very successful. It was decided that a second meeting should be held in 1892, either in London or in Cambridge, during the month of August.

— A company has been organized in Brussels for the purpose of constructing a railway from Matadi to Stanley Falls on the Kongo. The road, as projected, will have a length of about 270 miles, and is intended to surmount the difficulties of traffic on the cataract region of the lower Kongo.

— Captain Phythian, the Superintendent of the Naval Observatory, Washington, states that the preparations for the expedition to Africa to observe the total eclipse of the sun, which occurs in December next, are being actively pushed forward. The smallness of the appropriation by Congress for this work, \$5,000, necessitates careful expenditures, and it will be impossible to send the expedition to St. Paul de Loando, where the observations will take place, except on a Government vessel. The expedition will sail about Oct. 1.

— An ancient treatise on anatomy has been unearthed at the Royal Library at Berlin. It was written in Latin in 1304, by Henry de Mondeville, professor of surgery at Paris and Montpellier, and body-surgeon to Philip le Bel. Surgeon de Mondeville was at one time on English soil as an army surgeon, and his death took place in 1318. The book has never been printed. It is valuable as throwing light upon a period concerning whose medical history there is but little known.

— A. J. Drexel, banker, of Philadelphia, proposes to purchase land, construct the necessary buildings, and provide for the maintenance of instructors and all things necessary for the establishment of an industrial institute for young men and women that will be capable of accommodating a thousand of each sex. This plan is a substitute for one proposed some time since, to establish an industrial college for girls in the country, near Philadelphia. It was found that there were several serious obstacles to such a project, and in its stead Mr. Drexel undertakes to establish and maintain this larger and more general institute. The institute will probably be modeled somewhat after the Cooper Institute of New York, and it is expected that the cost will be about a million and a half of dollars.

— A new Austrian patented process for silvering articles of iron is thus described: The article is first plunged in a pickle of hot dilute hydrochloric acid, whence it is removed to a solution of mercury nitrate, and connected with the zinc pole of a Bunsen element, gas carbon of platinum serving as the other pole. It is rapidly covered with a layer of quicksilver, when it is removed, washed, and transferred to a silver bath and silvered. By heating to 572 degrees F. the mercury is driven off, and the silver firmly fixed on the iron. To save silver the wire can be first covered with a layer of tin; 1 part of cream of tartar is dissolved in 8 parts of boiling water, and one or more tin anodes are joined with the carbon pole of a Bunsen element. The zinc pole communicates with a well-cleaned piece of copper, and the battery is made to act till enough tin has deposited on the copper, when this is taken out and the ironware put in its place. The wire thus covered with tin chemically pure and silvered is much cheaper than any other silvered metals.

— Mr. M. E. Allison of Hutchinson, Kan., in a letter to *The American Field*, says, "An experience I had lately with a quail (Bob White) was so interesting to me, I thought it might interest some of my brother sportsmen who are better acquainted with the habits of the quail than I am. In the corner of our coursing park there was a quail's nest, and it was so near to the road that when

we would be passing by it, to and from the park, the old quail would fly away, and it was always the male bird. My never seeing the female around there is what attracted my attention; and I noticed that the male was crippled in one leg, and only used one in hopping about, and appeared to be crippled otherwise. There were twelve eggs in the nest, and after ten or twelve days from the time I first noticed it the young brood all hatched, and the old male bird took them and left the nest. The female bird was never seen anywhere in that neighborhood by myself or any of the men at work there, and some of us were there every day; but we never failed to find him on the nest. I came to the conclusion that someone had killed the female while she was laying the eggs, and at the same time wounded the male; and he, knowing his companion was gone, took charge of the nest and set on the eggs, hatched them, and is now raising the little orphans on his own hook. If these are the facts, and it seems to be so, is it not a very remarkable case?"

— At a recent meeting of the Paris Geographical Society, M. G. Rolland contributed some valuable data to the discussion, recently carried on between him and M. E. Blanc, on the subject of the yield of artesian wells in north Africa. After expressing his agreement with M. Blanc regarding the fundamental principles which regulate artesian basins generally, he proceeded to controvert the latter's assertion that in the case of the Ued Rir the admitted gain in the yield of water was not in proportion to the number of new wells sunk. M. Rolland adduced a table, recently compiled by him and M. Jus, showing the number of French wells in the Ued Rir, their total output per minute, and the average output of each well for the nine years ending in June, 1889. In 1880 there were 64 wells, with a total yield of 22,865 gallons a minute, or an average of 357; in 1889 there were 127 wells, with a total yield of 44,908 gallons a minute, or an average of 354, showing that while the number of wells had doubled, the yield had very nearly doubled also. He admitted that in certain parts of the Ued Rir, notably the central part, the limit of yield had been reached. He concluded by suggesting that there should be some authority to regulate the number and position of all new wells to be sunk.

— Henry L. Bolley, assistant botanist at the Indiana Agricultural Experiment Station, Purdue University, thus sums up the results of some investigations on wheat rust recently made by him. The rusting of wheat is due to the attacks of several species of minute fungi. The disease is propagated by means of various spores, one form of which is developed upon various determined and undetermined plants, mostly weeds. This side form is not, as yet, proved to be essential to the continued life of the parasites, but its destruction decreases the danger from serious attacks of the disease. One species (*P. rubigo vera*) in its uredo stage is able to pass the winter in the tissues of the young wheat plant. In warm weather, any conditions of the soil or atmosphere which tend to keep the wheat leaves constantly wet are conducive to the rapid spread of the disease. Low-lying, rich soils are most subject to the disease. No variety of wheat is known to be rust proof, yet some possess greater powers of resistance than others. Though not proved, an excess of nitrogen in the soil is to be considered, probably, as liable to produce wheat easily affected by rust. If fertilizers are to be applied to such lands, those containing only inorganic elements are most advantageous so far as immunity against rust is concerned. In districts liable to severe visitations of the disease, early-ripening wheats are to be preferred.

— Henry Shaw, a well-known philanthropist of St. Louis, died on Aug. 25 in that city. He was an Englishman, and at the age of nineteen years he came to this country, settling in St. Louis in 1819, where he embarked in the hardware business. After twenty years of commercial life he amassed a sufficient fortune to enable him to retire from business. He made a tour of the world, occupying about ten years in travel. On his return to St. Louis he began the study and cultivation of plants and flowers, and it was in the prosecution of these studies that the botanical gardens containing fifty acres, near Tower Grove Park, had their origin. He made the park and gardens free to the public, and now, with his death, the gardens become the property of the State of Missouri. Tower Grove Park, comprising 350 acres, becomes the property of the

city. The Shaw estate is estimated to be worth \$2,500,000, and it is thought the greater part will be left to St. Louis in various bequests.

— The Royal Danish Academy of Sciences invites research on the following among other subjects: Compounds of alcohol radicals with copper, silver, or gold, and compounds of polyvalent alcohol radicals with metals (all unknown at present): prize, a gold medal. The fatty acids in the fat of butter; to be isolated and determined, and relations indicated especially between the quantities of oleic acid and those of palmitic acid and their higher homologues: prize about \$160. The *Mycorhiza* of the beech; are they different in different kinds of humus? does the structure of the mycelium give a basis for classification? is there a reciprocal symbiosis, the fungus preparing food for the plant, etc.: prize, about \$160. Memoirs to be sent to Professor Zeuthen of Copenhagen before Oct. 31, 1890, except in the last case, for which the date is Oct. 31, 1891.

— The dwarf trees which the Japanese horticulturists are showing at the Paris Exhibition are attracting much attention. Pines, thujas, and cedars, said to be one hundred or one hundred and fifty years old, are only eighteen inches high, and with such specimens, as *Garden and Forest* says, it would be easy to have a coniferous forest on a balcony. These arboreal deformities are produced by great labor, and, if the truth is told about their ages, this work of arresting the tree's development and forcing it into contorted forms must be persisted in by several generations of foresters. All this painstaking is hardly paid for by the beauty of the resulting abortions, but, as has been suggested, a look at these trees will explain where the fantastic forms come from which serve as models for the plants we see on the lacquered trays, bronzes, and embroideries which come from Japan.

— Until recently very little was known of the fossil flora of Japan. The first systematic treatment of it is found in the work of Dr. H. T. Geyler who, in 1877, described and figured twelve species of jurassic plants collected by Dr. J. Rein in the valley of the Tetorigawa in Kaga. Three years later the same author referred to the occurrence of *Carpinus grandis* Unger in the tertiary formation of Mikawa in Honsha. This was the only literature relating to the fossil flora of Japan down to the year 1881, when for the first time, Professor A. G. Nathorst of Stockholm published a preliminary communication on more than seventy species of tertiary plants collected by Professor Nordenskiöld on his visit to Japan during the famous Vega expedition around the Asiatic continent. This work was soon followed by a more complete one, in which leaves collected by Hilgendorf are also described. The work principally treats of the young pliocene, or, perhaps, the oldest quaternary flora of Mogi, a very important group, from which the author was able to draw interesting conclusions as to the origin and climatic relations of the recent flora. In this work he also mentions twelve species of the older tertiary plants from Ezo (Hokkaido) and Honshu determined by Leo Lesquereux, but which were up to that time yet unpublished. During the last two years the Geological Survey has sent to Professor Nathorst a large collection of tertiary plants for investigation, on a part of which he has already drawn up a brief preliminary report. These were exclusively from northern and central Japan. For the most part they belonged to the older tertiary, corresponding in age to the floras of Sachalin and Alaska. Professor Nathorst mentions in this paper plants collected by Mr. Petersen at Nagasaki. About these, and the plants last sent, chiefly including those of Shikoku and Kyushu, he will write other memoirs. By the study of these fossils quite a comprehensive idea may be formed regarding the tertiary flora of Japan; but as to the mesozoic flora nothing further has been done since the publication of the work by Dr. Geyler. Since Dr. Rein's discovery of jurassic plants, the valley of the Tetorigawa has been twice visited by geologists. The first visit, a very short one, was made in 1880 by Dr. B. Koto. On his return he made a brief report, accompanied by a sketch-map of the river valley and four geological sections. The second and more extensive visit was undertaken by Mr. Tadataku Kochibe. In 1883 the Imperial Geological Survey undertook the reconnaissance of various parts of central Japan, one of which was a region including the provinces of Kaga, Hida, Echizen, and Etchu, between the parallels of 35° and 37° north lati-

tude. The survey was conducted by Mr. T. Kochibe as geologist and Mr. K. Kodari as topographer. This survey, which lasted three months, brought back many interesting fossils, some of which, together with those formerly collected by Dr. Koto, form the subject of a paper, by Matajiro Yokoyama, recently published in the Journal of the College of Science of the Imperial University of Japan. As a detailed account of this survey will appear in future reports of the Geological Survey, the gentleman mentioned merely indicates briefly the general outline of the geographical and geological features of this part of Japan.

— In February of this year, the *Deutsche Heeres-Zeitung* gave some interesting particulars of the new, almost smokeless powders which are being made by the united Rhine and Westphalian factories. With a 0.5-centimetre Krupp gun, 35 calibres long, an initial velocity of 527 metres was given to a projectile of 18 kilograms, with 3.9 kilograms of the powder, under a pressure of 1,955 atmospheres. It is now reported that, at a subsequent trial with the same gun, a projectile of 18.15 kilograms received an initial velocity of 542 metres, with a pressure of only 1,942 atmospheres, 4 kilograms of the powder being used, while, when the charge was increased to 4.5 kilograms the velocity was 586 metres, and the average pressure 2,300 atmospheres. The following are the results with another variety of the same large-grain powder. With a 12-centimetre gun and projectile of 26.2 kilograms: Charge, 5 kilograms; velocity, 472 metres; pressure, 1,240 atmospheres. Charge, 7.5 kilograms; velocity, 621 metres; pressure, 2,270 atmospheres. Gun of 13 centimetres, and projectile of between 30.01 and 30.27 kilograms: Charge, 5.5 kilograms; velocity, 512 metres; pressure, 1,340 atmospheres: Charge, 6.5 kilograms; velocity, 625 metres; pressure, 2,010 atmospheres. Gun of 15 centimetres, and projectile of 51.5 kilograms: Charge, 10 kilograms; velocity, 501 metres; pressure, 1,630 atmospheres. Charge, 14 kilograms; velocity, 617 metres; pressure, 2,550 atmospheres.

— In summing up the Maybrick case, Justice Stephen's remarks were rather severe upon expert testimony, medical and other. He warned the jury about the uncertainty of medical science, or rather art, and reminded them of the old saying which described a doctor as "a man who passed his time in putting drugs of which he knew little into a body of which he knew less." He also had a fling at the experts in other fields who appear before parliamentary committees and the like. He said a man going on the stand, and "calling himself this, that, or the other, by no means qualified him to receive unhesitating belief." "A great deal of what he might call scum had to be taken off the testimony of skilled witnesses, for — of course, probably insensibly to themselves — they were apt to become advocates rather than witnesses."

— Some new light on the subject of indirect vision, i.e., vision with the lateral parts of the retina, is thrown by recent experiments made by Kirschmann, and reported in *Nature*. The common idea that the sensitiveness of the retina diminishes outwards to the periphery appears to be incorrect. There is an objective diminution of light-action when a source of light is moved away laterally from the middle of the field of vision, for the mass of penetrating light gets less. Hence, were the diminishing sensitiveness a fact, a luminous surface should seem to lose brightness when moved to the side; but it does not, though it appears less distinct in outline and modified in color. Kirschmann placed two rotatory disks made up of moveable black and white sectors, giving any degree of brightness, before the observer; who shut one eye, and looked at the middle of one disk, about a metre and a half from him, while he gave his attention to comparing the brightness of the second disk, seen at different angles, by indirect vision. The figures from numerous experiments prove that in the horizontal meridian the sensibility to brightness has a maximum at 22° to 25° from the centre, while in the vertical direction the maximum is at 12° to 15°. The growth of sensibility is much greater in the horizontal than in the vertical direction, and the upper part of the retina is superior in this respect to the lower. This corresponds to the needs of vision. Indirect vision with lateral parts of the retina is more important than that with the upper and lower regions, and the upper half is more important than the lower.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....\$3.50 a year.

Great Britain and Europe..... 4.50 a year.

Science Club-rates for the United States and Canada (in one remittance):

1	subscription 1 year.....	\$ 3.50
2	" 1 year.....	6.00
3	" 1 year.....	8.00
4	" 1 year.....	10.00

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VOL. XIV. NEW YORK, AUGUST 30, 1889. No. 343.

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ON MONDAY OF THIS WEEK the executive branch of the committee on site and buildings for the World's Fair held its first meeting in the committee rooms in the *Times* building. The members present were Charles A. Dana, chairman; John Foord, secretary; ex-Mayor Grace, Henry R. Towne, Isidor Straus, Samuel Gompers, C. F. Chandler, and John H. Starin. On motion of Mr. Towne it was resolved that Central Park, as a site for the fair, be excluded from immediate consideration. It was also decided to lay aside, for the present at least, all suggestions in regard to sites not on or near Manhattan Island, and to divide the water front and inland site propositions into two groups for separate consideration. Accordingly the secretary was requested to organize two excursions for a personal inspection by the committee of all the sites deemed worthy of examination. The first trip was on the water, starting from the foot of East Thirty-second Street at 12 o'clock Wednesday, Mr. Starin supplying the steamer. As Randall's, Blackwell's, and Ward's Islands have been suggested for consideration, the committee decided to invite the presidents of the board of charities and correction and the board of emigration to join the excursion party. The trip was continued up to Pelham Bay Park and other available water-front plots. The second excursion was fixed for Thursday, but the hour and place were left open. The New-York Central Railroad Company has offered a special car for the use of the committee on its inland trip, which will probably be largely devoted to

the annexed district. Whatever conclusions the committee reach will be reported to the main committee for approval or rejection. While the committee was in session Mr. Erastus Wiman called to recommend certain sites on Staten Island. The committee spent considerable time in looking over the scores of suggestions as to sites. The work of sorting was not an easy task, but the sifting process resulted in a list of a dozen or twenty.

IT IS ONE of the self-evident truths that the grounds of neat and painstaking farmers and gardeners should not be permitted to become annually seeded with weeds from the lands of their more slovenly neighbors. It seems that in Wisconsin there is on the statute books a law intended to prevent this injustice, and which needs only to be enforced to accomplish much good. This law does not, as is pointed out in a recent bulletin of the agricultural station of the University of Wisconsin, demand the destruction of all pernicious weeds, but it is aimed at the principal offenders, and if these can be kept under subjection by its means, the damages from these pests on the farm will be materially reduced. It is a matter of interest that all the weeds condemned in the law were introduced into this country from Europe. There are, it is true, native species of the cocklebur, but Dr. Gray believes that the one that has become a troublesome weed, and has very justly been included in the weed law, is not native, but has been naturalized here. The fact that these troublesome weeds have invaded our country from other continents, and, despite the efforts that have been put forth for their destruction, have spread themselves over so many of our farms, illustrates how great is their power to cope with conditions, and emphasizes the importance of vigorous concerted action to keep them under subjection.

MR. WALLACE ON DARWINISM.¹

TO ALL who have read the life and letters of the late Mr. Darwin it must appear that, over and above the personal and scientific interest which attaches in so high a degree to that admirable biography, there is what may be termed a dramatic interest. The antecedents of Charles Darwin, the Sir Isaac Newton of biology, in Charles Darwin, the undergraduate at Cambridge—hitherto unconscious of his own powers, and waking up to a love of science under the guiding influence of a beautiful friendship; the delight and the diffidence which attended his nomination by Professor Henslow as a suitable naturalist for the "Beagle" expedition; the uncertainty which afterwards marked the course of negotiations between his family on the one hand, and the Admiralty on the other, wherein issues of incalculable importance were turning and re-turning in the balance of chance, determined this way and that by the merest featherweights of circumstance; the eventual suddenness of a decision which was destined to end not only, as his father anticipated, in an "unsettling" of his own views, but also, and to a never paralleled degree, in the unsettling of the views of all mankind; the subsequent dawning upon his mind of the truth of evolution in the light of his theory of natural selection, and the working out of that theory during twenty years of patient devotion in the quiet retirement of an English country life; the bursting of the storm in 1859, and all the history of the great transformations which have followed;—these in their broadest outlines are some of what I have ventured to call the dramatic elements in the records of Mr. Darwin's life.

Now, not least among these dramatic elements is the relation in which Mr. Darwin's work stood to that of Mr. Wallace. For assuredly it was in the highest degree dramatic, that the great idea of natural selection should have occurred independently and in precisely the same form to two working naturalists; that these naturalists should have been countrymen; that they should have agreed to publish their theory on the same day; and last, but not least, that, through the many years of strife and turmoil which followed, these two English naturalists consistently maintained towards each other such feelings of magnanimous recognition, that

¹ From the *Contemporary Review*.

it is hard to say whether we should most admire the intellectual or the moral qualities which, in relation to their common labors, they have displayed.

Now, I have sought to lay emphasis on this the dramatic side of "Darwinism," because in the work which under this title I am about to review, it appears to me that Mr. Wallace has added yet another scene, or episode, which, in the respects we are considering, is quite worthy of all that has gone before. I do not allude merely to the fact that in this work we have the matured conclusions of the joint-originator of Darwinian doctrine, published most opportunely at a time when biological science is especially anxious to learn his views upon certain questions of the highest importance which have been raised since the death of Darwin; nor do I allude merely to the further fact that in now speaking out, after nearly a decade of virtual silence on scientific topics, the veteran naturalist has displayed an energy of investigation as well as a force of thought which is everywhere equal to, and in many places surpasses, anything that is to be met with in all the solid array of his previous works. That these facts present what I call the dramatic side I fully allow; but the point which in this connection I desire to bring into special prominence is the following.

It is notorious that, from the time when they published their joint theory of evolution by natural selection, Darwin and Wallace failed to agree upon certain points of doctrine, which, although of comparatively small importance in relation to any question of evolution considered as a fact, were, and still continue to be, of the highest possible importance in relation to the question of evolution considered as a method; i.e., in relation to the causes or factors which have been concerned in the process. It was the opinion of Mr. Darwin that natural selection has been the chief, but not the only, cause of organic evolution; while, in the opinion of Mr. Wallace, natural selection has been the all and in all of such evolution, — virtually the sole and only principle which has been concerned in the development both of life and of mind from the amœba to the ape, — although he further and curiously differs from Darwin in an opposite direction, by holding that natural selection can have had absolutely no part at all in the development of faculties distinctively human. Disregarding the latter and subordinate point of difference, — a re-presentation of which in the concluding chapters of his present work, I may however remark, appears to me sadly like the feet of clay in a figure of iron, marring by its manifest weakness what would otherwise have been a completed and self-consistent monument of strength, — let us first clearly understand to what it is that the major point of difference amounts. This may best be done by quoting from each of the authors in question parallel passages, which occur in the concluding paragraphs of their latest works.

Mr. Darwin writes: "I have now recapitulated the facts and considerations which have thoroughly convinced me that species have been modified during a long course of descent. This has been effected chiefly through the natural selection of numerous successive, slight, favorable variations, aided in an important manner by the inherited effects of the use and disuse of parts; and in an unimportant manner, that is in relation to adaptive structures, whether past or present, by the direct action of external conditions, and by variations which seem to us in our ignorance to arise spontaneously. It appears that I formerly underrated the frequency and value of these latter forms of variation, as leading to permanent modifications of structure independently of natural selection. But as my conclusions have lately been much misrepresented, and it has been stated that I attribute the modification of species exclusively to natural selection, I may be permitted to remark that in the first edition of this work, and subsequently, I placed in a most conspicuous position — namely, at the close of the introduction — the following words: 'I am convinced that natural selection has been the main, but not the exclusive, means of modification.' This has been of no avail. Great is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure."

Mr. Wallace writes: "While admitting, as Darwin always admitted, the co-operation of the fundamental laws of growth and variation, of correlation and heredity, in determining the direction of lines of variation or in the initiation of peculiar organs, we find

that variation and natural selection are ever-present agencies, which take possession, as it were, of every minute change originated by these fundamental causes, check or favor their further development, or modify them in countless varied ways according to the varying needs of the organism. Whatever other causes have been at work, natural selection is supreme, to an extent which even Darwin himself hesitated to claim for it. The more we study it, the more we are convinced of its overpowering importance, and the more confidently we claim, in Darwin's own words, that it 'has been the most important, but not the exclusive, means of modification.' "

Now, in the latter quotation it is manifest that the "co-operation" which is spoken of takes cognizance only of factors which are themselves either necessary conditions to, or integral parts of, the process of natural selection; and, therefore, the approval which Mr. Wallace bestows upon Mr. Darwin's emphatic reservation — "but not exclusive means of modification" — can only be understood to have reference to the development of those distinctively human faculties which he immediately proceeds to consider, and touching which, as already indicated, Mr. Darwin's reservation was certainly not intended to apply. Thus, in brief, at the time of Mr. Darwin's death the state of matters was this: while Mr. Wallace held persistently to his original belief in natural selection as virtually the sole and only cause of organic evolution, the whole body of scientific opinion, both in this country and abroad, had followed Mr. Darwin in holding that, while natural selection was "the main" factor of such evolution, nevertheless it was largely supplemented in its work by certain other subordinate factors, of which the most important were taken to be the inherited effects of use and disuse, together with the influence of the environment in directly producing alterations both of structure and of instinct.

Shortly after Mr. Darwin's death, however, this state of matters underwent a very serious change. For it was shortly after Mr. Darwin's death that Professor Weismann began to publish a remarkable series of papers, the effect of which has been to create a new literature of such large and rapidly increasing proportions that, with the single exception of Mr. Darwin's own works, it does not appear that any publications in modern times have given so great a stimulus to speculative science, or succeeded in gaining so influential a following. The primary object of these papers is to establish a new theory of heredity, which has for one of its consequences a denial of the inherited effects of use and disuse, or, indeed, of any other characters which are acquired during the lifetime of individuals. According to this theory, the only kind of variations that can be transmitted to progeny are those which are called congenital.

For instance, there is no doubt that in his individual lifetime the arms of a blacksmith have their muscular power increased by constant exercise or use of the muscles in hammering; and therefore, if there were a thousand generations of blacksmiths, it seems reasonable to suppose that the children of the last of them would inherit somewhat stronger arms than those of average children, — or, *à fortiori*, than those of children born of a similarly long line, say, of watchmakers. This was the supposition that constituted the basis of Lamarck's theory of evolution, and, as we have seen, it was sanctioned by Darwin; although, of course, he differed from Lamarck in not regarding this supposed transmission of the effects of use and disuse as the sole factor of evolution, but merely as a factor greatly subordinate to that which he had himself discovered in survival of the fittest. Nevertheless, he unquestionably did regard this subordinate factor as one of high importance in co-operation with survival of the fittest, and, as Mr. Herbert Spencer has shown in detail, he apparently attributed more and more importance to it the longer that he considered its relation to the greater principle.

But, as we have just seen, according to the school of Weismann it is only variations of a congenital kind that can be inherited. No matter what adaptive changes may be induced in the individual by suitable use and disuse of its several parts, and no matter what adaptive changes may be directly caused by environing agencies, these all count for nothing in the process of evolution. The only adaptive changes that can count for anything in this process are those which can be transmitted to progeny; i.e., according to this

school, those which arise fortuitously as congenital variations, for the accidental occurrence of which natural selection is always, so to speak, waiting and watching. The human hand, for example, considered as a mechanism, owes nothing to its continued use through numberless generations as an instrument for the performance of functions which it is now so admirably adapted to discharge; on the contrary, its evolution has throughout been exclusively dependent on the occurrence of fortuitous variations, which, whenever they happen to occur in a profitable direction, were preserved by natural selection, and passed on to the next generation. Now, it is evident that, according to this theory, natural selection is constituted the one and only cause of organic evolution; and for this reason the followers of Weismann are in the habit of calling his doctrine "pure Darwinism," inasmuch as without invoking any aid from the Lamarckian principles above described, it constitutes the Darwinian principle of natural selection the sole, and not merely as he said the "main, means of modification."

Obviously, without going further than this quotation, which I have already made from the last edition of the "Origin of Species," it is a misnomer to designate the doctrine in question "pure Darwinism." That quotation presents the only note of bitterness which is to be met with in the whole range of Mr. Darwin's writings, and it is a note which has express reference to this very point. Notwithstanding the multifarious directions in which his doctrines were abused, the only protest against "steady misrepresentation" that he has ever allowed himself to lodge, he lodged against those who imputed to him this so-called doctrine of "pure Darwinism." On the other hand, it is no less manifest that this doctrine, although not pure Darwinism, assuredly is, and always has been, pure "Wallaceism." In point of fact, it is with reference to this very doctrine of natural selection as the sole cause of organic evolution that the opinion of these two renovators of biology has been from the first divided. It is upon this point, and upon this point alone, that there has ever been any serious difference between them, — for, as we shall presently find, every other point in which they failed to agree, save with respect to the origin of man, has a direct logical reference to this one, or grows out of this one by way of logical consequence.

And here we arrive at what seems to me the dramatic interest attaching to Mr. Wallace's latest work. On the present occasion I am not going to consider the pros and the cons of the momentous question which has always divided his teaching from that of his great compatriot. But, whether he is right or whether he is wrong, he has lived to see a most extraordinary revolution of biological thought in the direction of opinions which have always been distinctively his own, and which for a large part of a lifetime he has been virtually alone in maintaining.

Yet, notwithstanding the gratification with which Mr. Wallace must have watched this remarkable change within the last few years, there is in his recently published book no sound of exultation. On the contrary, his aim everywhere appears to be that of concealing his personal interest in this matter; and so well does he succeed that, after having finished his book, not one in a hundred of his readers will be in a position to surmise that for more than a quarter of a century their author has steadily maintained the opinions which are now being adopted by an influential and rapidly increasing body of evolutionists. Therefore, it is partly for the sake of drawing attention to a claim which Mr. Wallace characteristically abstains from making on his own behalf that I ventured to write this review of his latest work. If ever there was an occasion when a man of science might have felt himself justified in expressing a personal gratification at the turning of a tide of scientific opinion, assuredly such an occasion is the present; and in whichever direction the truth may eventually be found to lie, historians of science should not omit to notice that in the very hour when his lifelong belief is gaining so large a measure of support Mr. Wallace quietly accepts the fact without one word of triumph.

To me individually it does not appear that the recent movement of scientific opinion in the direction of "Wallaceism" is scientifically justifiable; and therefore I remain an adherent of "Darwinism," as this was left by the matured judgment of Darwin. For, on the one hand, I cannot find that the school of Weismann has

added anything of importance to the body of facts previously known; while, on the other hand, I do find that Professor Weismann himself is put to the sorest straits while trying to maintain his theory in the presence of some of these facts. So that, while fully recognizing the extraordinary ability with which he has marshalled his evidence, — and also, it may be added, the great service which he has rendered to biological science in raising certain questions of the highest possible importance in the acutest possible form, — I must still confess that to my mind there does not seem to have been hitherto shown any adequate reason to pass from the theory of evolution as this was always held by Darwin, to the theory of evolution as it has always been held by Wallace. Therefore I am free to conclude this article by briefly considering the points upon which Wallace, in his matured publication on "Darwinism," expressly differs from the teachings of Darwin.

As already stated, all these points of difference, with the one exception as to the origin of man, arise by way of logical necessity from the great or radical difference which we have hitherto been considering; viz., as to whether natural selection is only the "main" or actually "the exclusive means of modification." Nevertheless, it is desirable to consider what Mr. Wallace has to say upon these secondary or sequent points of difference, because, by examining them in the light of the diverse facts which they severally involve, we may obtain valuable material for guiding our judgment upon the larger issue.

Sexual Selection.

Against Mr. Darwin's theory of sexual selection, — i.e., selection which depends on the superior power which males may be supposed to present in the way of charming their females, — Mr. Wallace urges the following objections, which, in his opinion, are sufficient to dispose of the theory *in toto*.

In the first place, he argues that the principal cause of the greater brilliancy of male animals in general, and of male birds in particular, is that they do not so much stand in need of protection arising from concealment as is the case with their respective females. Consequently natural selection is not so active in repressing brilliancy of color in the males, or, which amounts to the same thing, is more active in "repressing in the female those bright colors which are normally produced in both sexes by general laws."

Next, he argues that not only does natural selection thus exercise a negative influence in passively permitting more heightened color to appear in the males, but even exercises a positive influence in actively promoting its development in the males, while, at the same time, actively repressing its appearance in the females. For heightened color, he says, is correlated with health and vigor; and as there can be no doubt that healthy and vigorous birds best provide for their young, natural selection, by always placing its premium on health and vigor in the males, thus also incidentally promotes, through correlated growth, their superior coloration.

Again, with regard to the display which is practised by male birds, and which constitutes the strongest of all Mr. Darwin's arguments in favor of sexual selection, Mr. Wallace points out that there is no evidence at all of the females being in any way affected thereby. On the other hand, he argues that this display may be due merely to general excitement; and he lays stress upon the more special fact that movable feathers are habitually erected under the influence of anger and rivalry, in order to make the bird look more formidable in the eyes of his antagonists.

Furthermore, he adduces the consideration that, even if the females are in any way affected by color and its display on the part of the males, and if, therefore, sexual selection be conceded a true principle in theory, still we must remember that, as a matter of fact, it can only operate in so far as it is allowed to operate by natural selection. Now, according to Mr. Wallace, natural selection must wholly neutralize any such supposed influence of sexual selection. For, unless the survivors in the general struggle for existence happen to be those which are also the most highly ornamented, natural selection must neutralize and destroy any influence that may be exerted by female selection. But obviously the chances against the otherwise best fitted males happening to be likewise the most highly ornamented must be many to one, unless, as Wallace supposes, there is some correlation between embellishment and general perfection, in which case, as he points out, the theory

of sexual selection lapses altogether, and becomes but a special case of natural selection.

Once more, Mr. Wallace argues that the evidence collected by Mr. Darwin himself proves that each bird finds a mate under any circumstances, — a general fact which in itself must quite neutralize any effect of sexual selection of color or ornament, since the less highly colored birds would be at no disadvantage as regards the leaving of healthy progeny.

Lastly, he urges the high improbability that through thousands of generations all the females of any particular species — possibly spread over an enormous area — should uniformly and always have displayed exactly the same taste with respect to every detail of color to be presented by the males.

Now, without any question, we have here a most powerful array of objections against the theory of sexual selection. Each of them is ably developed by Mr. Wallace himself in his work on tropical nature; and although I have here space only to state them in the most abbreviated of possible forms, I think it will be apparent how formidable these objections appear. Unfortunately the work in which they are mainly presented was published several years after the second edition of the "Descent of Man," so that Mr. Darwin never had a suitable opportunity of replying. But, if he had had such an opportunity, as far as I can judge, it seems that his reply would have been more or less as follows: —

In the first place, Mr. Wallace fails to distinguish between brilliancy and ornamentation — or between color as merely "heightened," and as distinctively decorative. Yet there is obviously the greatest possible difference between these two things. We may readily enough admit that a mere heightening of already existing coloration is likely enough — at all events in many cases — to accompany a general increase of vigor, and therefore that natural selection, by promoting the latter, may also incidentally promote the former, in cases where brilliancy is not a source of danger. But clearly this is a widely different thing from showing that not only a general brilliancy of color, but also the particular disposition of colors in the form of ornamental patterns, can thus be accounted for by natural selection. Indeed, it is expressly in order to account for the occurrence of such ornamental patterns that Mr. Darwin constructed his theory of sexual selection; and therefore, by thus virtually ignoring the only facts which that theory endeavors to explain, Mr. Wallace is not really criticizing the theory at all. By representing that the theory has to do only with brilliancy of color, as distinguished from disposition of colors, he is going off upon a false issue which has never really been raised. Look, for example, at a peacock's tail. No doubt it is sufficiently brilliant; but far more remarkable than its brilliancy is its elaborate pattern, on the one hand, and its enormous size, on the other. There is no conceivable reason why mere brilliancy of color, as an accidental concomitant of general vigor, should have run into so extraordinary, so elaborate, and so beautiful a pattern of colors. Moreover, this pattern is only unfolded when the tail is erected, and the tail is not erected in battle, as Mr. Wallace's theory of the erectile function in feathers would require, but in courtship. Obviously, therefore, the design of the pattern, so to speak, is correlated with the act of courtship, — it being only then, in fact, that the general design of the whole structure, as well as the more special design of the pattern, becomes revealed. Lastly, the fact of this whole structure being so large, entailing not only a great amount of physiological material in its production, but also of physiological energy in carrying about such a weight, as well as of increased danger from impeding locomotion and inviting capture, — all this is obviously incompatible with the supposition of the peacock's tail having been produced by natural selection.

And such a case does not stand alone. There are multitudes of other instances of ornamental structures imposing a drain upon the vital energies of their possessors, without conferring any compensating benefit from a utilitarian point of view. Now, in all these cases, without any exception, such structures are ornamental structures which present a plain and obvious reference to the relationship of the sexes. Therefore it becomes almost impossible to doubt, first, that they exist for the sake of ornament, and next, that the ornament exists on account of that relationship. If such structures were due merely to a superabundance of energy, as Mr. Wallace

supposes, not only ought they to have been kept down by the economizing influence of natural selection, but we can see no reason, either why they should be so highly ornamental, on the one hand, or so exclusively connected with the sexual relationship, on the other.

For these reasons I think that Mr. Wallace's main objection falls to the ground. Passing on to his subsidiary objections, I do not see much weight in his merely negative difficulty as to there being an absence of evidence upon hen birds being charmed by the plumage or the voice of their consorts. For, on the one hand, it is not very safe to infer what sentiments may be in the mind of a hen; and, on the other hand, it is impossible to conceive what motive can be in the mind of a cock, other than that of making himself attractive, when he performs his various antics, displays his ornamental plumes, or sings his melodious songs. Considerations somewhat analogous apply to the difficulty of supposing so much similarity and constancy of taste on the part of female animals as Mr. Darwin's theory undoubtedly requires. Although we know very little about the psychology of the lower animals, we do observe in many cases that small details of mental organization are often wonderfully constant and uniform throughout all members of a species, even where it is impossible to suggest any utility as a cause.

Again, as regards the objection that each bird finds a mate under any circumstances, we have here an obvious begging of the whole question. That every feathered Jack should find a feathered Jill is perhaps what we might have antecedently expected; but when we meet with innumerable instances of ornamental plumes, melodious songs, and the rest, as so many witnesses to a process of sexual selection having always been in operation, it becomes irrational to exclude such evidence on account of our antecedent prepossessions.

There remains the objection that the principles of natural selection must necessarily swallow up those of sexual selection, as the fat kine swallowed up the lean in the dream of Pharaoh. And this consideration, I doubt not, lies at the root of all Mr. Wallace's opposition to the supplementary theory of sexual selection. He is self-consistent in refusing to entertain the evidence of sexual selection, on the ground of his antecedent persuasion that in the great drama of evolution there is no possible standing-ground for any other actor than that which appears in the person of natural selection. But here, again, we must refuse to allow any merely antecedent presumption to blind our eyes to the actual evidence of other agencies having co-operated with natural selection in producing the observed results. And, as regards the particular case now before us, I think I have shown, as far as space will permit, that in the phenomena of decorative coloring, as distinguished from merely brilliant coloring, of melodious song, as distinguished from merely tuneless cries, of enormous arborescent antlers, as distinguished from merely offensive weapons, and so forth, — I say that in all these phenomena we have phenomena which cannot possibly be explained by the theory of natural selection; and, further, that if they are to be explained at all, this can only be done, so far as we can at present see, by Mr. Darwin's supplementary theory of sexual selection.

I have now briefly answered all Mr. Wallace's objections to this supplementary theory, and, as previously remarked, I feel pretty confident that, at all events in the main, the answer is such as Mr. Darwin would himself have supplied, had there been a third edition of his work upon the subject. At all events, be this as it may, we are happily in possession of unquestionable evidence that he believed all Mr. Wallace's objections to admit of fully satisfactory answers. For his very last words to science — read only a few hours before his death at a meeting of the Zoological Society — were, "I may perhaps be here permitted to say, that, after having carefully weighed, to the best of my ability, the various arguments which have been advanced against the principle of sexual selection, I remain firmly convinced of its truth."

Inherited Effects of Use, Disuse, and Direct Action of Environment.

We have just seen that one of Mr. Wallace's strongest arguments against sexual selection consists in representing *à priori*

that there can be no room for the operation of such a principle in the presence of natural selection: the greater principle must swallow up the less. This *à priori* argument he extends to all the other supplementary principles which have ever been suggested, and appears to regard it as "a short and easy method" with the Darwinists. He urges it with special vehemence against the so-called Lamarckian principles, and therefore it is suitable that under this head we should consider more carefully the value of such an argument.

In the present connection this argument is that, even admitting the abstract possibility of Lamarckian principles, in the presence of natural selection they could never have an opportunity of acting, inasmuch as the needful changes would be effected by a natural selection of fortuitous variations more rapidly than they could be by an inheritance of the effects of use and disuse. Now this argument admits of two rejoinders. First, it is surely conceivable that in many cases where slight (because initial and afterwards finely graduated) improvements are concerned, such improvements need not have been, in every stage of their progress, matters of life and death to the organisms presenting them. Yet, unless at every stage of their progress they were matters of life and death, they could not have been produced by the unaided influence of natural selection. Now it is just in such cases that the supplementary or Lamarckian principles are supposed by Darwinists to come in; for to the operation of these principles it is not necessary that at each stage of the process every slight improvement should be a matter of life and death to the organisms presenting it. To me it appears that we have here a consideration of the highest importance. Nowadays no one disputes the supremacy of natural selection over all other principles of organic change hitherto suggested, or even, it may be predicted, suggestable. But this acceptance of natural selection as supreme by no means necessitates (as Mr. Wallace appears to imagine) acceptance of natural selection as unique. Nor is there any incompatibility between our acceptance of natural selection as supreme and a further acceptance of any other principles as subordinate or co-operative. What we all agree upon is, that no such other principles can act, save in so far as they are allowed to act by natural selection; but to maintain that there can be no room for the action of any other principle hitherto suggested, or in the future suggestable, appears to me extravagant. At all events, the burden of proof must lie with any one who affirms that no adaptive improvement — or, indeed, change of any kind — can ever take place unless every stage in the gradual process has been a matter of life and death to the organisms presenting it, a burden of proof which it is obviously impossible that any one can ever be in a position to discharge.

In view of this consideration it seems to me that Mr. Wallace's *à priori* objection to the abstract possibility of Lamarckian principles falls to the ground, although of course the question remains whether there is any sufficient evidence *à posteriori* of their operation in actual fact. And a virtual answer to this question appears to me to be involved in the second consideration, which, as above stated, remains to be adduced.

Long ago Mr. Herbert Spencer pointed to the facts of co-adaptation within the limits of the same organism as presenting the strongest possible evidence of Lamarckian principles working in association with Darwinian. Thus, taking one of Lamarck's own illustrations, Mr. Spencer showed that there must be thousands and thousands of changes — extending to all the organs and even to all the tissues of the animal — which in the course of numberless generations have conspired to turn an antelope into a giraffe. Now the point is that, throughout the entire history of these changes, their utility must have always been dependent on their association. It would be useless that an incipient giraffe should present a tapering down of the hind-quarters, unless at the same time it presented a tapering up of the fore-quarters; and as each of these modifications entails innumerable subordinate modifications throughout both halves of the creature concerned, the chances must be infinity to one against the required association of so many changes happening to arise by way of merely fortuitous variation. Yet, if we exclude the Lamarckian interpretation as adopted by Darwin, which gives us an intelligible cause of co-adaptation, we are required to suppose that such a happy concurrence of innu-

merable co-adaptations must have occurred by mere accident, and this thousands and thousands of times in the bodies of as many successive ancestors of the existing species; for, at each successive stage of the improvement, natural selection (if working alone) must have needed all, or at any rate most, of the co-adaptations to occur in the same individual organisms.

Against this formidable consideration Mr. Wallace adduces the following rejoinder: "The best answer to this objection may, perhaps, be found in the fact that the very thing said to be impossible by variation and natural selection has been again and again effected by variation and artificial selection." This analogy he then enforces by special illustrations, etc., but does not appear to perceive that it really misses the whole point of the difficulty against which it is brought.

The point of the difficulty is, not that the needful variations do not occur, but that they occur associated in the same individual, and that unless they do thus occur associated in the same individual they must be useless; i.e., cannot fall under the sway of natural selection. Therefore the analogy of artificial selection is here irrelevant, seeing that it fails in respect of the very point which it is adduced to meet. The difference between natural selection and artificial selection is, that, while the former acts with exclusive reference to the utility (or life preserving character) of variations, the latter acts without such reference. Hence, there is obviously no difficulty in understanding how artificial selection is able to choose this, that, and the other congenital variation as each happens to occur in so many different individuals, and, by suitable pairing, to blend them together in any required proportions. But artificial selection is able to do this simply because the selected individuals do not depend for their lives upon presenting the blended characters which it is the object of such selection to produce. Natural selection, on the other hand, if working alone must wait until the blended characters happen to arise fortuitously in the same individuals; in all cases, that is, where utility depends on the co-adaptation of characters, which are the only cases now under consideration. Thus the two forms of selection present absolutely no point of analogy in the very respects where it is necessary that they should, if Mr. Wallace's appeal from one to the other is to be logically justified. In the one case the association of characters is purposely produced by the selection; in the other case it must arise by chance before its resulting utility can be offered to the selection.

Natural Selection as a Cause of Sterility Between Species.

After matured deliberation Mr. Darwin came to the conclusion that natural selection could not be a cause of sterility between species. Mr. Wallace now furnishes an argument to show that in this respect also Mr. Darwin "underrated" the powers of natural selection. The argument, however, is too abstruse to admit of reproduction here. On the present occasion, therefore, I will merely remark that it does not seem so much as to try to meet the considerations which determined Mr. Darwin's judgment in the opposite direction. Nevertheless the theory is profound as well as ingenious, and, although it fails to convince me, I am glad to note that in the course of its exposition Mr. Wallace appears to sanction the essential principle of my own hypothesis of "physiological selection;" viz., to quote his own words, "it is by no means necessary that all varieties should exhibit incipient infertility, but only some varieties; for we know that of the innumerable varieties that occur but few become developed into distinct species, and it may be that the absence of infertility, to obviate the effects of intercrossing, is one of the usual causes of their failure." The words which I have italicized very tersely convey the whole gist of "physiological selection."

Later on, however, he criticises adversely what I have written upon this subject, and also represents me as having misunderstood Mr. Darwin's views with respect to the utility and inutilty of specific characters. On both these points I shall have an answer to make on some future and more suitable occasion. In this article I have confined attention to points wherein Mr. Wallace differs from Mr. Darwin; and although in so doing it has been necessary for me to express uniform disagreement with the author of "Darwinism," this has been due only to the limitations of my project, and

in no way prevents my cordial appreciation of his work as a whole. Indeed, with the exception of those differences from Mr. Darwin, which it has been my object on the present occasion to consider, it appears to me that Mr. Wallace's latest work is one of the most interesting and suggestive in the whole range of Darwinian literature. And even these points of difference, it will be remembered, all arise out of the single difference before stated, namely, whether natural selection is to be regarded as the main, or as the exclusive, means of modification. Therefore, notwithstanding all that I have said on the Darwinian side of this momentous question, the fact that it still remains an open question compels us to recognize that Mr. Wallace's views with regard to it may eventually prove to be right; while, in any case, he is certainly to be congratulated on having lived to see the great movement which has recently taken place in the direction of those views. But to many of us it still appears that Mr. Darwin's judgment on this matter is the sounder one to follow. When a great generalization has been fairly established, there is always a tendency to exaggerate its scope; and, perhaps, in no respect was the wonderful balance of Mr. Darwin's mind so well displayed as it was in the caution with which he abstained from assigning to his vast principle of natural selection a sole prerogative. Moreover, as previously stated, the longer that he pondered the question, the more he became persuaded that the problem of organic evolution as a whole was too complex and many-sided to admit of being resolved by the application of a single principle. This conclusion, I believe, will eventually be justified by the advance of biological science; and, therefore, until some better reason is shown than has yet been shown for departing from it, I cannot help feeling that naturalists will do well to suspend their judgments, even if they are not so sure as they used to be touching the doctrines of "Darwinism," as these were left by Darwin.

GEORGE J. ROMANES.

BOOK-REVIEWS.

Stellar Evolution and its Relation to Geological Time. By JAMES CROLL. New York, Appleton. 12°. \$1.

THE basis of the theory advanced by Mr. Croll is that it is just as possible for the universe to have been created with a given amount of energy due to the motion of the created masses of matter, as with a given amount of matter; i.e., Mr. Croll would have the initial state that of a great number of cold bodies moving with high velocities. No one can deny the possibility of the truth of such a hypothesis, and many will find in Mr. Croll's deductions much that is suggestive. As it is not so probable that such initially moving bodies would collide as it is that bodies would if possessed only of motion of translation due to gravity, Mr. Croll thinks he sees in this universe created in motion a universe the better provided against the dissipation of its energy.

If we are to criticise the book, we would call attention to the unsatisfactory nature of all discussions of problems in mechanics, — and many of those in stellar physics are such, — by one who makes no pretence of being a mathematician. Yet as the mathematicians have not given the geologists all the time they call for that the solar system may have reached its present state with at least one planet built up of well ordered crystalline and fossiliferous rocks, it is to be expected that some flaw may be found in the calculations of the one or the theories of development of the other; and such suggestions as Mr. Croll has to offer will help in bringing the two parties to an agreement.

AMONG THE PUBLISHERS.

A. S. BARNES & CO. announce that the long-promised "The Three Germanys," by Theodore S. Fay, has now been issued.

— Callaghan & Co. will publish, on Oct. 1, Vvol. 6 of Von Holst's "Constitutional History of the United States."

— "King's Annotated Vest-Pocket Map of Massachusetts" is the most perfect small map of the State that has ever appeared.

— John C. Yorston & Co., Cincinnati, have just ready Henry A. Shepherd's "The Antiquities of Ohio," reprinted from the "Popular History of the State of Ohio."

— The Pacific Press Publishing Company have just issued "The Federal Government of Switzerland," by Bernard Moses, professor of history and political economy, University of California.

— John Ireland, 1197 Broadway, has the market for a new cook-book, "What One Can Do with a Chafing-Dish," just published by the author, H. L. Sawtelle. Experimenters in "light-house-keeping" will find the book just the one they have been in search of for so many years.

— Fords, Howard, & Hulbert have ready a new contribution, by a new writer, to the present all-absorbing discussion of the future of the negro in America, entitled "An Appeal to Pharaoh." The author confidently indorses it as "a radical solution of the negro problem."

— "Recollections of the Court of the Tuilleries," by Madame Carotte, is a recent book of reminiscences of the court of the last Napoleon, which is being widely read in France. It contains many memoirs of the Empress Eugénie. A translation is in hand, and will be published immediately by D. Appleton & Co.

— P. Blakiston, Son & Co., Philadelphia, have just ready a revised and enlarged edition of "Obstetric Nursing," by Theophilus Parvin, M.D., Professor of Obstetrics and Diseases of Women and Children in the Jefferson Medical College, and Obstetrician to the Philadelphia Hospital.

— The *Journal of Pedagogy* enters upon its third volume with the September issue. Dr. A. D. Mayo of Boston, the well known educational lecturer, stated in the annual address at the Ohio University, June 20, 1889, that "the *Journal of Pedagogy* is one of the two or three real educational papers in this country." It is published at Athens, Ohio.

— The author of the "Rise and Fall of the Confederate Government," Mr. Jefferson Davis, is not satisfied with the limited sale his work has had. He has complained so loudly of its failure as compared with the works of Grant and Sherman, that D. Appleton & Co., his publishers, have gained his consent to the appointment of arbitrators to decide the points at issue between them. The Messrs. Appletons attribute the slow demand made in the North for the book to the intense sectional spirit in which it is written.

— The Lounger writes in *The Critic*: "I heard the other day from an authority which I cannot dispute that 'The Century Dictionary' has cost the Century Co. over \$500,000, and my informant added parenthetically that when the undertaking was begun, the company had no idea that it would swallow up a sum approximating this. But like Topsey it 'grow'd.' It has taken nearly seven years of the time of some of the best experts and specialists in the country, at an annual expense of not very much less than \$100,000. This, I believe, is the first time the cost of making this great dictionary has been stated with any degree of accuracy."

— Mr. Paul Leicester Ford, whose address is No. 97 Clark Street, Brooklyn, N.Y., will have ready in September "American Bibliography: A Check-List of Bibliographies, Catalogues, Reference Lists, and Lists of Authorities of American Books and Subjects," a quarto volume printed on alternate pages, and containing 1,070 titles, arranged by subject under 19 divisions and 150 subdivisions, with a classification of contents and an author's index. At the same time Mr. Ford will bring out his "Franklin Bibliography: a List of Books written by or relating to Benjamin Franklin," an edition of 500 copies uniform in size with Bigelow's octavo edition of Franklin's Works. No fewer than 1,500 titles and references are promised, the list of works wholly or in part written by Franklin numbering 600, and his pseudonyms amounting to 60. There will be chronological, classical, and general indices, and mention of the libraries where the works may be consulted.

— "The Dominion of Canada is a device to keep the peace between those to whom Nature has allotted an irrepressible conflict." So says the writer of an article called "La Nouvelle France" in the September *Atlantic*, which will be the subject of discussion in the United States, and of something more than discussion in Canada. It shows how the French Canadian party is steadily gaining Canada to itself, and how by its consummate organization,

it is reconquering it from its nominal English rulers. The paper is an interesting pendant to that on French-Canadian literature in the August number; and it will, as has been said, no doubt call out some rejoinders. "The Isthmus Canal and American Control," by Stuart F. Weld, is a consideration of the policy promulgated by the United States government in its desire to control the inter-oceanic canal, with (as eighteenth century writers would put it) "some animadversions thereon." In fact, the magazine runs toward political questions, since Mr. Frank Gaylord Cook has an article on "James Wilson," a Scotchman who settled in Pennsylvania, and whose services in behalf of the Constitution of the United States are too little known. Still another sketch, of the "Americans at the First Bastille Celebration" (by J. G. Alger), completes the more important articles.

— Ginn & Company have just published "The Irregular Verbs of Attic Prose; their Forms, Prominent Meanings, and Important Compounds, together with Lists of Related Words and English Derivatives," by Addison Hogue, Professor of Greek in the University of Mississippi. The material treated in this book is much fuller than in the lists of irregular verbs in the grammars, and more accessible than in the lexicons. The book contains after the regular verbs, — pure, mute, and liquid, — the irregular verbs of Attic prose in alphabetical order. Prominent meanings and special uses of frequent occurrence are given, often illustrated by translated examples. The most important compounds are added, and also many related words, — forming a very practical sort of introduction to word-formation. The first declension alone is represented by about four hundred substantives, and this indicates the range of vocabulary. The English derivatives, of which there are over 450, should prove an attractive feature to teachers and students alike. To the latter they will be an additional support in learning some five or six hundred Greek words, and will broaden their knowledge of their own tongue.

— In the September *Magazine of American History* Mr. Robert Stiles, of Richmond, tells of "Lincoln's Restoration Policy for Virginia," which Admiral Porter, with whom Lincoln went to Richmond on its evacuation, represented differently in his "Incidents of the Civil War." The evidence here given for the first time to the public corrects even Grant's account of the matter in his "Memoirs," which is believed to have been written from hearsay. The illustrated feature of the magazine this month is the third chapter in Mrs. Lamb's "Historic Homes and Landmarks," the scene being the site of the Damen farm, between Wall Street and Maiden Lane, which for nearly half a century was outside the walled city of New York. Many new facts and figures have been exhumed by the accom-

plished historian, the most consequential landmarks are described, events are vividly portrayed which made the ground historic, and never before were the wonderful contrasts between the past and the present so sharply defined. A second illustrated paper, by T. H. Lewis, of St. Paul, is "The Old French Post at Trempealeau, Wis.," a recent discovery. Gen. J. W. De Peyster pays a tribute to the late "John W. Hammersley," whose portrait in steel forms the frontispiece to the issue. Milton T. Adkins writes the "Growth of a Great National Library," giving the history in brief of the library of Congress. William Seton contributes an article of interest on "St. John de Crèvecoeur, the First French Consul in New York after the Revolution." There is a sketch of "New York's Great Landholder, George Clarke," and a tribute to the late Mrs. Amasa J. Parker.

— A number of years ago Mr. J. C. Pilling undertook the compilation of a bibliography of North American languages. In the course of his work he visited the principal public and private libraries of the United States, Canada, and northern Mexico, carried on an extensive correspondence with librarians, missionaries, and others interested in the subject, and examined such printed authorities as were at hand. The results of these researches were embodied in a single volume. Since its issue he has had an opportunity to visit the national libraries of England and France, as well as a number of private ones in both these countries, and to revisit a considerable number in this country and Canada. A sufficient amount of new material has thus been collected to lead to the belief that a series of catalogues may well be prepared, each referring to one of the more prominent groups of our native languages. Of this series three have been published, relating respectively to the Eskimauan, the Siouan, and the Iroquoian families. The fourth has just been issued by the Bureau of Ethnology, and relates to the Muskogean languages; the fifth, now in preparation, will relate to the Algonquian. There are in the present catalogue 521 titular entries, of which 467 relate to printed books and articles and 54 to manuscripts. Of these, 469 have been seen and described by the compiler, — 429 of the prints and 40 of the manuscripts, — leaving as derived from outside sources 38 printed works and 14 manuscripts. Of those unseen by the writer, titles and descriptions of more than one-half have been received from persons who have actually seen the works and described them for him. In addition to these, there are given a number of full titles of printed covers, second and third volumes, etc., all of which have been seen and described by the compiler; while in the notes mention is made of 69 printed and manuscript works, 43 of which have been seen and 26 derived from other (mostly printed) sources.

INDUSTRIAL NOTES.

Guaranty Investment Company.

THE Guaranty Investment Company has adopted the policy of sending each year a committee of its investors to visit Kansas and Nebraska and report upon its loans and methods of business. The first report was made in 1888 and the second in 1889. The committee of 1888 consisted of Professor A. H. Berlin, principal of the high school, Montrose, Penn. (recently removed to Wilmington, Del.), and Major Theodore L. Poole, ex-United States pension agent, Syracuse, N.Y. They commenced their labors on Monday, June 18, 1888, by an examination of the books and statements submitted to them by the Western general manager, F. H. Wilson. Later, accompanied by the inspector of the company, they began an examination of some of the loans made by the company. This examination was commenced in Atchison County, Kan., on Tuesday, June 19, ending with Franklin County, Kan., Saturday, June 30. During this time they drove about four hundred miles and travelled by railroad seven hundred miles, and examined over forty loans made by the company. While they examined in detail over forty loans they also looked at many others in different counties that they did not have time to compare with the records. From their investigation and observations they recommended the loans made by the Guaranty Investment Company of Atchison, Kan., as a safe investment.

The committee for 1889 consisted of Dr. Francis W. Boyer, a

physician of Pottsville, Penn., M. H. Olin, president of the Citizens' Bank, Perry, N.Y., and Irving H. Tift, Esq., a lawyer of New York City. From the report, dated Atchison, Kan., June 29, 1889, it appears that their work began on Thursday, June 6, and ended on Friday, June 28. During this period they travelled over 2,150 miles, 665 of which were by carriage, and visited a large portion of Kansas and Nebraska. The trip took them through twenty-eight counties in Kansas and twenty-six in Nebraska, besides a large number of cities and towns in both States. Before commencing the journey they made an examination of the books and records of the company, submitted for inspection by the Western general manager, Mr. Frank H. Wilson. In conclusion they say that it is their opinion that Kansas and Nebraska are on the high road to prosperity, and do not see how it is possible for carefully placed farm mortgages in these States to be otherwise than safe, and they regard those of the Guaranty Investment Company to be of this character.

Any persons desiring further information upon points in the reports are requested to correspond with any member of either committee, and copies of testimonials received from persons who have made investments in these mortgages will be sent to any address. The company keeps on hand at its New York office at all times a large number of seven per cent guaranteed mortgages equal in security to any examined by the committees, and full information will be gladly given to any one, by Henry A. Riley, general Eastern manager, 191 Broadway, New York.